Ontario
Energy
Board

Ontario

The Consumers' Gas
Company Ltd.

Proposed Liquified Natural
Gas Plant

E.B.R.L.G 29

REPORT OF THE BOARD

REPORT OF THE BOARD

E.B.R.L.G. 29

IN THE MATTER OF a reference from the Lieutenant Governor in Council to hold a public hearing to examine the proposed construction by The Consumers' Gas Company Ltd. of a liquefied natural gas storage facility in Northumberland County, and to report thereon;

AND IN THE MATTER OF the Municipal Franchises Act, R.S.O. 1980, Chapter 309, as amended;

AND IN THE MATTER OF the Ontario Energy Board Act, R.S.O. 1980, Chapter 332, as amended;

AND IN THE MATTER OF an application by The Consumers' Gas Company Ltd. (1) for an Order granting leave to construct two natural gas transmission pipelines in the Township of Haldimand, County of Northumberland, and (2) for a Cerfificate of Public Convenience and Necessity to construct works to supply gas and to supply gas in the Township of Haldimand, County of Northumberland.

BEFORE:

R.W. Macaulay, Q.C.
Chairman and
Presiding Member

J.K. Shurie
Member

M.G. Munro
Member

December 12, 1986

Ontario

Ontario
Energy
Board

14 Carlton Street
Toronto, Ontario
M5B 1J2
416/598-4000

December 12, 1986

To His Honour the Lieutenant Governor in Council

The Ontario Energy Board was required by Order in Council No. 327/86 to examine, and after holding a public hearing to report on whether the LNG project, proposed by The Consumers' Gas Company Ltd., was in the public interest. Pursuant to the Order in Council, the Board examined the need for the project, the alternatives which could satisfy that need, the economic feasibility of the project and its alternatives, the design and safety of the project, the site selection process and the environmental impacts of the project.

Consumers' also applied to the Board for an Order granting leave to construct two pipelines and for a certificate of public convenience and necessity which would facilitate the operation of the LNG plant. These two applications were considered by the Board at the same time as the reference. A formal determination on these applications will be made by the Board following your Honour's response to this report.

The Board submits its report herewith.

Respectfully submitted,

ONTARIO ENERGY BOARD

R.W. Macaulay, Q.C.
Chairman and
Presiding Member

J.K. Shurie
Member

M.G. Munro
Member

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1. INTRODUCTION

Background

1.1 The Consumers' Gas Company Ltd. (the company or Consumers'), like other natural gas utilities in Ontario, obtains almost all of its gas from Alberta through the facilities of TransCanada PipeLines Limited (TCPL) for distribution through its own pipelines to customers in Ontario. This gas has traditionally been supplied and purchased under the terms of one or more contracts between the company and TCPL (i.e. Contract Demand (CD), Annual Contract Quantity (ACQ), Authorized Overrun Interruptible (AOI) and Winter Peaking Service (WPS)).

1.2 Natural gas users are generally either residential, commercial or industrial. Residential and commercial customers are considered temperature sensitive because they use natural gas chiefly for space heating purposes. The average level of their demand is affected by the size of their homes or work space. The peak level of their consumption, on the other hand, is affected mainly by the weather. Consequently, the temperature sensitive load is lowest in summer and highest in winter, reaching a peak on the coldest days in January or February.

1.3 Industrial customers use natural gas either to generate large quantities of process heat, usually as steam, or as a feedstock for the manufacture of a number of products such as plastics and fertilizers. The demand for gas by these industrial customers tends to vary only with the price of a competing fuel or with a change in economic activity.

1.4 Consumers' offers two classes of service, "firm" and "interruptible". Firm customers have priority on available gas and their supply may be curtailed only in extreme circumstances beyond the reasonable control of Consumers'. Interruptible customers obtain gas at a reduced price year-round in exchange for Consumers' right to interrupt or curtail their supply under specified circumstances.

1.5 Traditionally, Consumers' has met its winter peaking requirements by using a combination of WPS from TCPL, underground storage and curtailment of its interruptible customers.

1.6 In 1982, Consumers' perceived that demand for natural gas within its system was increasing sharply during the peak winter heating season. The company concluded that neither the pipeline facilities of TCPL, nor the available underground storage pools, nor the market for curtailable gas could meet its winter peaking requirements in the future.

1.7 After considering a number of alternatives to meet these future peak requirements, Consumers' selected a "peak shaving" process which involved the construction of a liquefied natural gas (LNG) facility. In the LNG process, gas is liquefied during the off-peak months, stored in a large tank and then regasified when needed and returned to the transmission and distribution system.

1.8 After a review of potential sites for the facility, Consumers' chose a location (referred to as Haldimand-3) about 127 kilometres east of Toronto, in the Township of Haldimand in Northumberland County, about 2.5 kilometres north of the village of Grafton.

1.9 On October 15, 1985, Consumers' applied to the Ontario Energy Board (the Board or the OEB) with respect to its proposed LNG facility. On January 30, 1986, by Order in Council No. 327/86, the Board was required to hold a public hearing to examine certain aspects of the LNG facility. The procedural elements of this proceeding are more fully addressed in Chapter 6 of this Report.

Consumers' Proposal

1.10 Consumers' proposes to construct the LNG facility on part of lots 18, 19, 20 and 21, Concession II, Haldimand Township, Northumberland County. The site is 179 hectares (ha) (442 acres) and is located approximately three kilometres south of the TCPL pipeline which will supply natural gas to the plant. Figure 1A depicts a general site plan of the proposed facility.

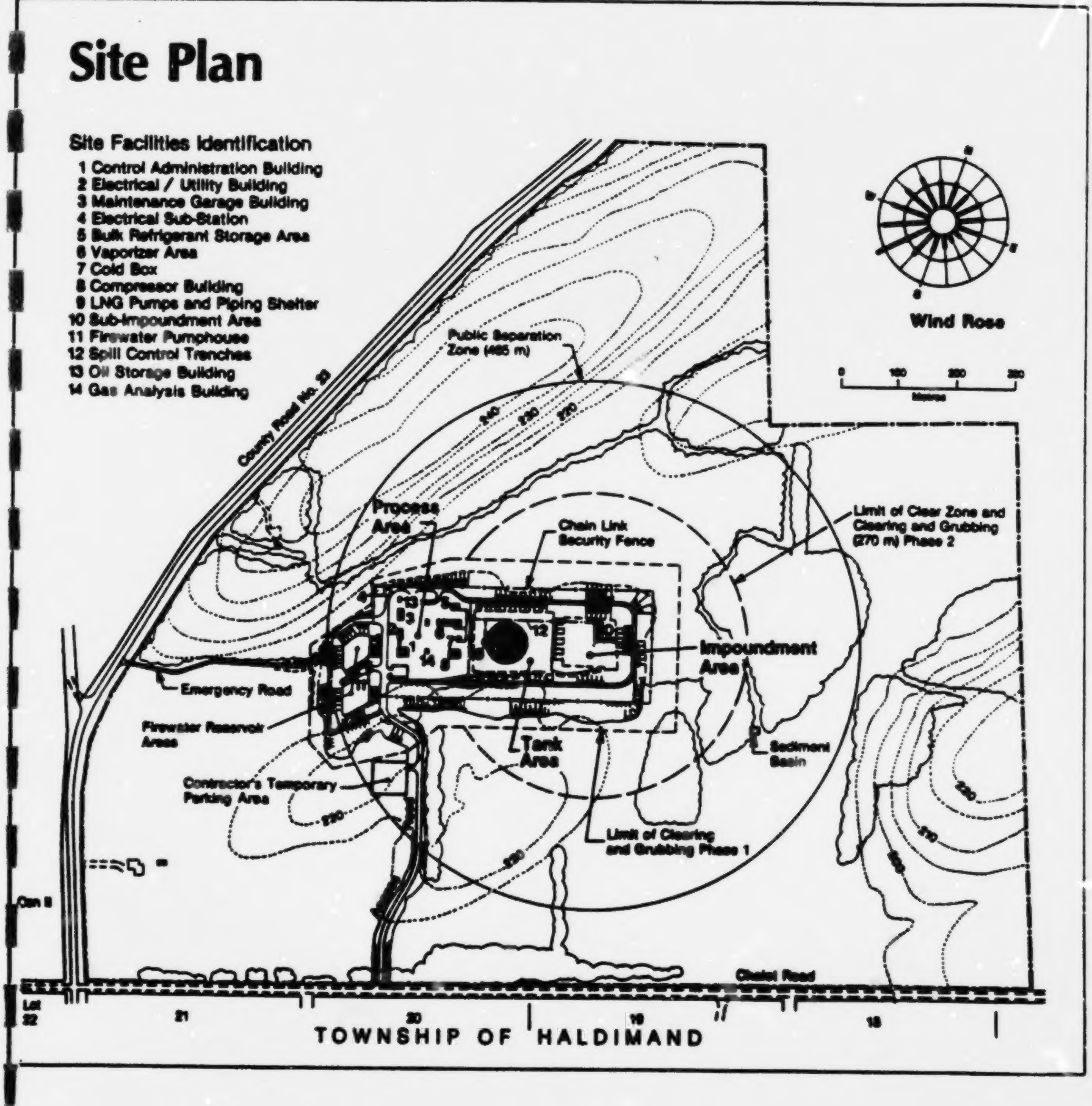
The Pipelines

1.11 Two pipelines are required to connect the LNG facility to the TCPL gas supply, a 406.4 millimetre diameter (Nominal Pipe Size (NPS) 16) steel pipeline, and a 168.3 millimetre diameter (NPS 6) steel pipeline.

The Processing Plant

1.12 The NPS 16 pipeline will be used to supply gas to the facility for liquefaction and will also be used to carry gas back to the TCPL line after vapourization.

Figure 1A



Site Plan

Site Facilities Identification
1 Control Administration Building
2 Electrical / Utility Building
3 Maintenance Garage Building
4 Electrical Sub-Station
5 Bulk Refrigerant Storage Area
6 Vaporizer Area
7 Cold Box
8 Compressor Building
9 LNG Pumps and Piping Shelter
10 Sub-Impoundment Area
11 Firewater Pumphouse
12 Spill Control Trenches
13 Oil Storage Building
14 Gas Analysis Building
Wind Rose
0 100 200 300
Metres
County Road No. 23
Public Separation Zone (465 m)
240
230
220
Process Area
Chain Link Security Fence
Limit of Clear Zone and Clearing and Grubbing (270 m) Phase 2
Impoundment Area
Emergency Road
Firewater Reservoir Areas
Tank Area
Sediment Basin
Contractor's Temporary Parking Area
230
Limit of Clearing and Grubbing Phase 1
Con II
Chalet Road
Lot 22
21
20
19
18
TOWNSHIP OF HALDIMAND

1.13 The process of liquefaction involves three basic steps: the removal of most of the non-methane components in the gas; the liquefaction of the gas by cooling; and the storage of the liquefied natural gas. The liquefied gas is then revapourized when required by the company.

1.14 Six hundred and eighteen cubic metres (618 m^3) of natural gas at 20°C and atmospheric pressure is reduced to one cubic metre (1 m^3) of LNG, when it is cooled to -162°C. It is this volume reduction that makes LNG an attractive and economic method of storing large quantities of natural gas.

1.15 The proposed LNG plant would be designed to meet a liquefaction rate of 283 thousand cubic meters (10^3m^3) per day of gas and a vapourization rate of 8,500 10^3m^3 per day. The proposed storage capacity of the tank is 92 10^3m^3 of liquid (56,600 10^3m^3 gas equivalent).

1.16 It would, therefore, take approximately 200 days to fill the storage tank with liquefied gas and approximately seven days to empty it at the design vapourization rate.

Feed Gas Purification

1.17 This operation removes liquid and gaseous impurities which if not removed, would freeze at the temperature of liquefied natural gas, hence damaging the equipment.

1.18 Filters are to be used to remove particulate matter. Water vapour, carbon dioxide and sulphur impurities are removed by chemical adsorbers and molecules of the impurities are retained by molecular sieves while permitting the cleaned gas to flow through.

Liquefaction of Gas

1.19 The purified gas flows through a set of heat exchangers where it is cooled to a temperature close to liquefaction. To liquefy natural gas, it must be cooled to -162°C, which is within a range of temperatures referred to as cryogenic. Consumers' has chosen the mixed refrigerant, closed-cycle liquefaction process. The term mixed refrigerant denotes the mixture of methane, ethane, propane, butane, pentane and nitrogen, which is used as the system's coolant. Methane will be supplied from the purified feed-gas stream while the other components are to be purchased in small quantities and stored on the site. The term closed-cycle means that after the initial charge of refrigerant, there are essentially no other refrigerant additions, except to make up for small losses.

1.20 The cooling of the natural gas is performed in two stages. In the first stage the gas is cooled sufficiently in the heat exchangers to liquefy the heavier hydrocarbons, which may be in the gas stream. These are separated and sent back into the TCPL pipeline. The lighter hydrocarbons, mainly methane, then flow through an expansion valve, liquefy, and flow into the storage tank.

1.21 During storage, a small amount of gas boils off which is then carried by the NPS 6 pipeline back to the TCPL line.

Storage

1.22 The proposed LNG storage facility has a tank within a tank. The space between them is filled with insulation. An insulated deck is suspended from inside the tank roof and the tank bottom is insulated with blocks to support the weight of the liquid.

1.23 The outer tank is constructed of normal carbon steel. It is to be air-tight so as to maintain pressure and to protect the insulation from the weather. The proposed storage tank will be approximately 65 metres in diameter and 40 metres in height.

1.24 The inner tank, which is in contact with the liquefied gas, is to be constructed of 9 per cent nickel steel which retains its strength and ductility at -162°C. Connections to the proposed tank are to be designed to accommodate the expansion and contraction resulting from changes in outside temperature.

1.25 The proposed storage tank is to be supported on a concrete ringwall and heating coils are to be provided under the tank to prevent freezing of the soil and consequent frost heaving.

Vapourization

1.26 The vaporization is to be accomplished by a set of four pump-vapourizer units (three in operation and a fourth as a stand-by unit) compressing the liquefied gas and then vapourizing it. The liquid, rather than the gas, is compressed so that the LNG can provide lubrication for the compressor bearings and cooling for its drive motor. In this way, both the pump and motor operate with their critical moving parts essentially submerged in liquefied gas in a closed system, minimizing the possibility of leaks.

1.27 For vapourization, a submerged combustion vapourizer is to be used in which the LNG passes through a stainless steel coil immersed in a tub of hot water which is heated by gas.

Buildings

1.28 The complete processing facility is to occupy about 30 ha of the 179 ha site and will be located approximately in the centre of the area. This arrangement has been selected to provide a cleared zone, sufficient to prevent a fire within the process area from spreading to the nearest trees or bushes, and a public separation zone sufficient to ensure the safety of the general public.

1.29 Four buildings are planned which will contain the control equipment and personnel, the compressors, the vapourizers and the maintenance equipment.

1.30 The control building will house the main control centre for monitoring and operating the plant. Offices and a meeting room will also be provided, together with specially designed rooms for analytical equipment.

1.31 The compressor building, heavily insulated for noise abatement, will house the compressors used in the process.

1.32 The vapourizer building, also heavily insulated for noise abatement, will contain the LNG vapourizers.

1.33 The maintenance and storage building will provide space and equipment for performing maintenance on plant equipment and for storing spare parts and supplies.

Staff Requirements

1.34 A staff of fifteen people is projected: one plant manager, one plant mechanic, one instrument technician, five shift supervisors, six plant operators and one plant secretary.

2. OVERVIEW OF THE REPORT

2.1 As required by Order in Council No. 327/86, in conducting the public hearing with respect to Consumers' proposal, the Board reviewed evidence relating to:

1. the need for the LNG facility;
2. the alternative methods for meeting that need;
3. the design and safety of the LNG facility;
4. the site selection process for the LNG facility; and
5. the environmental impacts associated with the LNG facility and the alternatives.

2.2 The Report of the Board has been prepared in a format which reflects the thought sequence followed by the Board in determining its findings and recommendations. The initial chapters are designed to provide the reader with some background on the evolution and development of the transmission and distribution of natural gas in Canada and Ontario.

2.3 A brief survey of the development of LNG technology over the past few decades is provided in Chapter 5 to familiarize the reader with the evolution of this method of storing natural gas.

2.4 The procedural aspects of the hearing are discussed in Chapter 6. The efforts of the Board and Consumers' to enhance public participation in the hearing are discussed in Chapter 7.

2.5 The need for facilities is scrutinized in Chapter 8.

2.6 The alternatives considered by Consumers' are explained and reviewed in Chapter 9 and the Board sets out the advantages, disadvantages and general feasibility of each. Included in the Board's review of alternatives is an analysis of a proposal submitted by Union Gas Limited (Union), during the course of the hearing, which involves two specific alternatives to meet Consumers' peak day gas needs.

2.7 Due, however, to the considerable controversy generated in the course of the hearing by Union's proposal, principally in relation to its feasibility and costs, the Board has provided a detailed comparison of the relative advantages and disadvantages of the LNG facility and Union's alternatives in Chapter 10.

2.8 As required by the Order in Council, the Board has also reviewed the design and safety of the LNG facility and submits its findings and recommendations on this aspect of the proposal in Chapter 11. This subject was extremely important to the Board and to those parties living in the vicinity of the preferred site for the LNG facility. The Board received a number of submissions from many of the residents of Haldimand Township on this aspect of the hearing.

2.9 The selection process employed by Consumers' in choosing a site for its LNG facility was reviewed and the findings and recommendations of the Board in relation to the strengths and weaknesses of the process are presented in Chapter 12.

2.10 The environmental impacts of the LNG project were also canvassed in the hearing and are addressed by the Board in Chapter 13. Chapter 13 also contains a review of the environmental impacts associated with Union's alternatives.

2.11 The Board further reviewed and considered the evidence in relation to the application by

Consumers' for leave to construct the pipelines to connect the LNG facility with the TCPL system. The design and safety aspects and the environmental impacts of the pipelines are discussed in Chapter 14.

2.12 A summary of the Board's findings and recommendations is set out in Chapter 15.

2.13 Costs awarded by the Board to intervenors who contributed to the hearing are detailed in Chapter 16.

2.14 A Glossary of Terms is provided in Appendix A to assist the reader in understanding the numerous technical terms included in this Report.

3. NATURAL GAS IN CANADA

Introduction

3.1 Natural gas is a hydrocarbon consisting principally of methane. In its pure state, methane is colourless and odourless and about half as heavy as air. One cubic foot of natural gas contains about 1,000 British Thermal Units (BTU) of heat energy.

3.2 Raw natural gas, as it comes from a well, may contain other hydrocarbons such as ethane, propane, butane and pentane. Also, there may be sulphur compounds which lead to sour gas because of their acidity. In addition, the removal of sulphur compounds improves the burning characteristics of natural gas and enables the recovery of elemental sulphur which can be used to make fertilizer and other products.

3.3 Raw natural gas also contains moisture and solid matter such as sand which, if not removed, would cause excessive wear, corrosion and fouling of transmission and distribution systems, leading to equipment failure. Since natural gas is primarily used as a fuel, these impurities must be removed to avoid causing unreliable and hazardous combustion.

3.4 Separation and removal of these materials is done at processing facilities normally located near the gas field. The type of processing facility required depends on the composition of the raw gas, which differs greatly from field to field. Processing will vary in complexity from a simple removal of water vapour to an extensive operation to remove sulphur compounds, non-combustible gases, water vapour, pentanes and heavier hydrocarbons.

The Discovery of Natural Gas

3.5 Natural gas was first discovered in Canada near Niagara Falls in 1794. The first natural gas well was completed in Moncton, New Brunswick, in 1859, followed by Port Colborne in 1866, Kamsack, Saskatchewan in 1874 and Ontario's first commercial well near Kingsville in 1889.

3.6 Alberta, although destined to add dramatically to the known store of energy in Canada, did not drill its first gas well until 1890. However, the drilling of the Leduc discovery well in 1947 touched off an intensive, widespread and long-term exploration program which has revealed very large reserves of natural gas and oil throughout western and northern Canada.

3.7 These discoveries in the late 1940's and early 1950's came at about the same time as advances in the technology of the manufacturing and installation of large-diameter pipe which promoted the development of projects for moving gas to major population centres.

The Transmission of Natural Gas

3.8 To address the problem of moving Alberta gas to the distant markets of eastern Canada, TCPL was incorporated in 1951 by Special Act of Parliament. In 1954, TCPL received permission to remove natural gas from Alberta. It was also granted a permit from the Federal Board of Transport Commissioners to construct a pipeline from Alberta to Quebec. In June, 1956, further legislation was passed by the federal government providing for a Crown corporation to construct the northern Ontario section of the pipeline.

3.9 Construction of the initial pipeline system from the Alberta-Saskatchewan border to Quebec was completed in 1958, and the benefits of natural gas were made available to millions of Canadians not previously served. Natural gas sales were enhanced, at that time, by the development of the domestic petrochemical industry and by increased exports to the United States.

3.10 In 1963, TCPL purchased the northern Ontario section of the pipeline from the Northern Ontario Pipeline Crown Corporation and thus took possession of the entire gas transportation system from Alberta to Quebec.

3.11 Most of the natural gas used in Ontario comes from approximately 650 producers in Alberta and is processed to remove impurities and separate liquid hydrocarbons. After this processing operation, the gas is collected and combined from the various producing areas into transmission lines owned principally by NOVA, An Alberta Corporation (NOVA) for delivery to long-distance carriers.

3.12 Gas for Ontario and other eastern markets leaves Alberta and the NOVA system at Empress, Alberta, where it enters the adjacent pipeline facilities of TCPL at Burstall, Saskatchewan.

3.13 As gas flows eastward from Alberta, the gas pressure decreases due to friction with the pipe wall. In order to keep flow rates at an acceptable level, the gas must be recompressed at compressor stations located along the transmission line at intervals of 80 to 160 kilometres.

3.14 From Winnipeg, two parallel lines move gas into Ontario and Quebec, with portions of a third line also in service in northern Ontario. The northern line branches at North Bay. One branch, the North Bay Shortcut, runs generally east and then south through eastern Ontario, while the other runs south to Toronto. There it branches again, with two lines travelling east along the north shore of Lake Ontario to Montreal while the other skirts west of Toronto and runs south to the Niagara peninsula connecting at the international border with pipelines serving the northeastern United States.

3.15 Gas also travels eastward from Winnipeg to markets in southwestern Ontario and the midwestern United States through facilities of the Great Lakes Transmission Company (GLTC), which is 50 per cent owned by TCPL.

3.16 The GLTC system runs south of Lake Superior and Lake Huron across Minnesota and northern

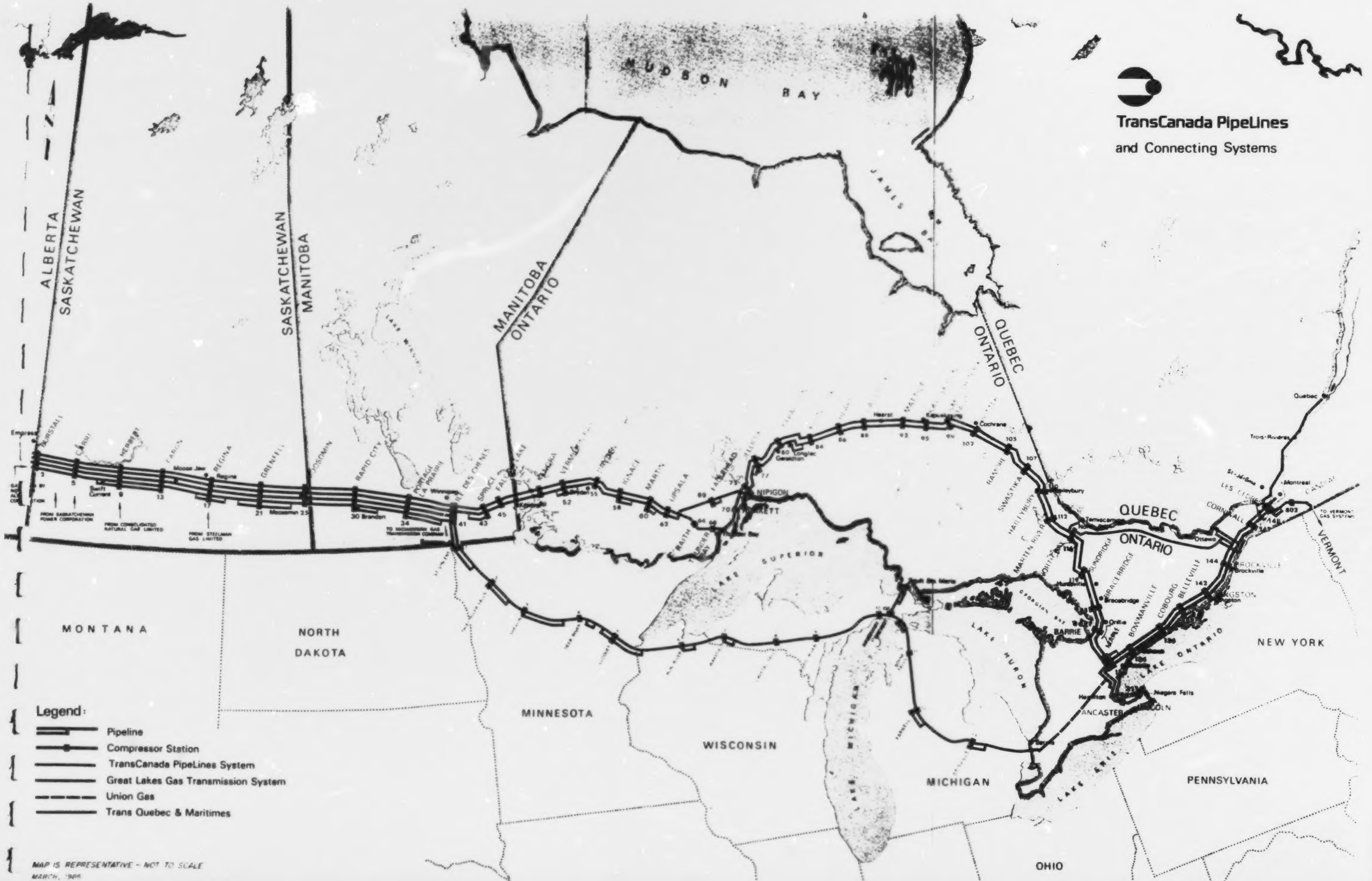
Wisconsin, then south through the state of Michigan with links to Canadian systems at Sault Ste. Marie and Sarnia. Near Sarnia, in Dawn Township, the gas is picked up and transmitted across southwestern Ontario by Union on its Dawn-Trafalgar transmission pipeline to the Trafalgar Station, near Oakville, where it either rejoins the TCPL pipeline running south to Niagara and east toward Montreal, or is connected to the Consumers' system. Figure 3A shows the TCPL system.

3.17 Expansion of the initial pipeline system by TCPL has continued in the form of new pipelines, looplines, additional compressor stations and additional power at existing stations - all to meet the increasing demand for natural gas. The total value of its assets is now more than $6 billion.

3.18 The present system extends along a 4,400 kilometre right-of-way consisting of 9,345 kilometres of pipeline and loopline and approximately 795,100 kilowatts of compressor power at 48 compressor stations.

Figure 3A

TransCanada PipeLines and
Connecting Systems


HUDSON BAY
JAMES BAY
ALBERTA
SASKATCHEWAN
SASKATCHEWAN
MANITOBA
MANITOBA
ONTARIO
QUEBEC
ONTARIO
QUEBEC
ONTARIO
Empress
BURSTALL
CARNE
HERBERT
CARON
REGINA
GRENFELL
MOOSOMIN
RAPID CITY
PORTAGE LA PRAIRIE
ILE DES CHENES
SPRUCE
FALCON LAKE
VERMILION
UPSALA
NIPIGON
Moose Jaw
Regina
Swift Current
Moosomin
Brandon
Winnipeg
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FROM SASKATCHEWAN POWER CORPORATION
FROM CONSOLIDATED NATURAL GAS LIMITED
FROM STEELMAN GAS LIMITED
TO MIDWESTERN GAS TRANSMISSION COMPANY
Hearst
Kapuskasing
Cochrane
RAMORE
SWASTIKA
HAILEYBURY
MARTEN RIVER
NORTH BAY
SUNDRIDGE
BRACEBRIDGE
BOWMANVILLE
COBOURG
BELLEVILLE
BROCKVILLE
KINGSTON
CORNWALL
LES CEDRES
Temiscaming
Ottawa
Brockville
Kingston
Huntsville
Bracebridge
Orillia
BARRIE
Hamilton
Niagara Falls
LANCASTER
LINCOLN
Quebec
Trois-Rivières
St-Jérôme
Montreal
TO VERMONT GAS SYSTEM
Sault Ste Marie
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
GEORGIAN BAY
LAKE ONTARIO
LAKE ERIE
MONTANA
NORTH DAKOTA
MINNESOTA
WISCONSIN
MICHIGAN
OHIO
NEW YORK
PENNSYLVANIA
VERMONT
Legend:
Pipeline
Compressor Station
TransCanada PipeLines System
Great Lakes Gas Transmission System
Union Gas
Trans Quebec & Maritimes

TransCanada PipeLines
and Connecting Systems

MAP IS REPRESENTATIVE - NOT TO SCALE
MARCH, 1986

4. NATURAL GAS IN ONTARIO

4.1 There are three major gas distributors in Ontario which together serve approximately 1,500,000 customers: Consumers', ICG Utilities (Ontario) Ltd (ICG) and Union. Each distributor operates an exclusive franchise within a given area: Union in southwestern Ontario; Consumers' in southern, central, and eastern Ontario; and ICG in northwestern, northern and eastern Ontario.

4.2 Without a guaranteed share of the market, the utilities would not have attracted the private sector investment needed to finance expensive pipeline construction. In exchange for freedom from competition, the utilities, in effect, gave up some freedom to set their own rates.

4.3 The three major gas distributors in Ontario each have different systems. The unique aspects of each distributor's system affect their ability to manage variations in demand, particularly during winter peaks.

4.4 ICG operates a natural gas distribution system consisting of approximately 5,600 kilometres of pipeline. ICG's net utility plant is expected to have an average value of approximately $343 million in its 1987 fiscal year. ICG projects that in 1987 it will deliver approximately 3,100 10^6m^3 of gas and will serve approximately 163,000 customers.

4.5 The storage available to ICG is very limited. It contracts with Union for approximately 99.1 10^6m^3 of gas. It also operates an LNG facility with a capacity of about 14.2 10^6m^3, when converted to gas, which is used for winter peaking purposes.

4.6 Union operates a fully integrated gas distribution system employing storage, transmission and distribution facilities. In its 1987 fiscal year it expects to sell over 7,300 10^6m^3. Union stores 2,000 10^6m^3 for its own use and stores some 650 10^6m^3 of gas annually for other utilities. In providing storage and transportation services, Union receives gas from TCPL at both its Dawn and Trafalgar delivery points.

4.7 On March 31, 1986, Union's assets totalled approximately $1.3 billion and its net utility plant investment was approximately $840 million.

4.8 The storage made available by Union plays a critical role in enabling TCPL to optimize the use of its delivery system. Union is the largest operator of underground storage pools in Ontario. In the summer period, a major portion of the gas delivered to Union is received at Trafalgar and is transported west to Union's storage pools near Dawn, in southwestern Ontario. In the winter period, the gas is removed from storage.

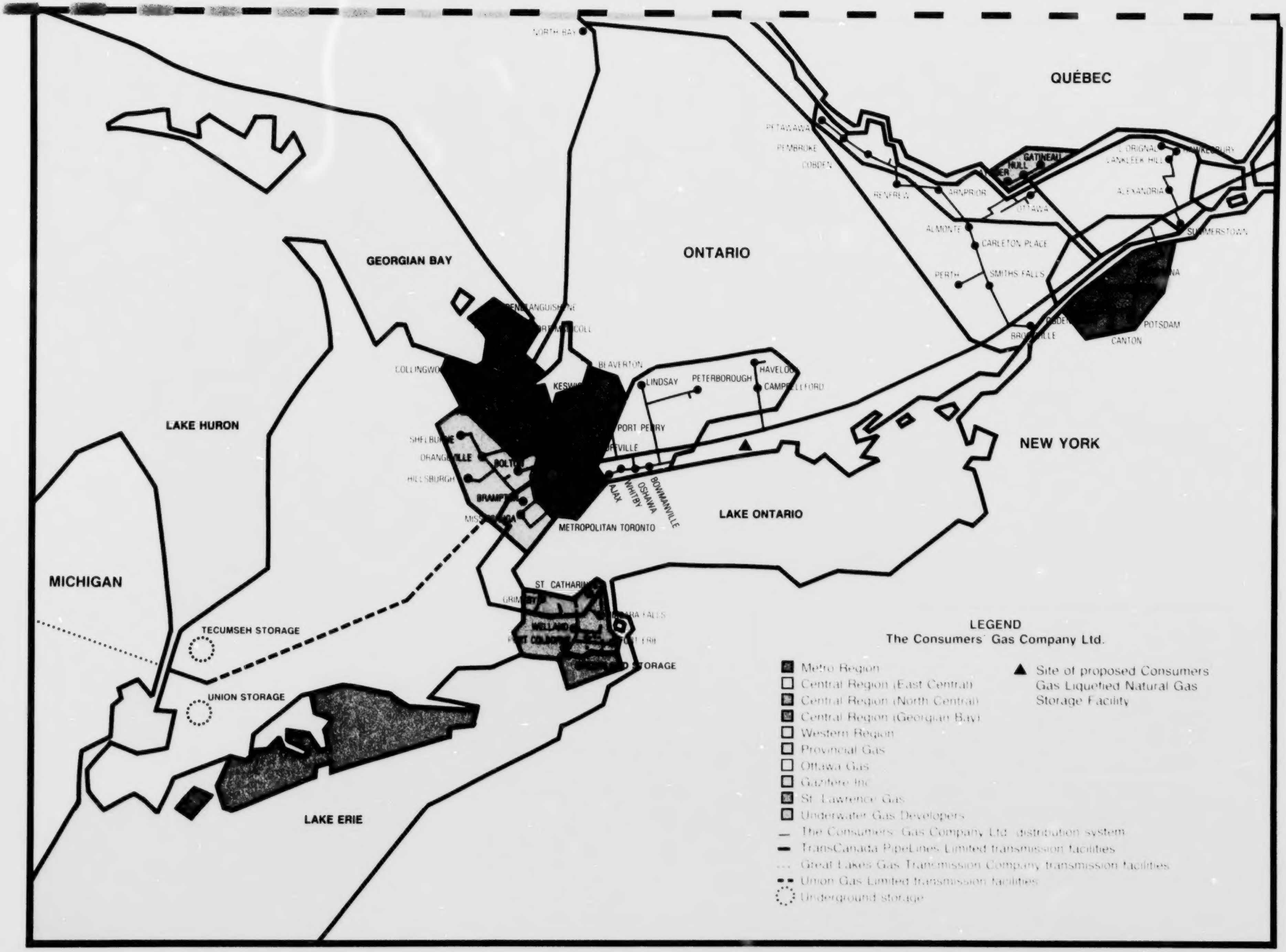
4.9 **Consumers'** is Canada's largest natural gas distributor, serving customers in Ontario, western Quebec and northern New York State. In its 1985 fiscal year, the company had total assets of $1.638 billion and distributed 9,100 10^6m^3 of gas to 821,556 customers through its network of 18,657 kilometres of mains. Figure 4A shows the Consumers' system.

4.10 In addition to its gas distribution activities, Consumers' is engaged in:

- the exploration for and the production of oil and gas, primarily in southwestern Ontario;

Figure 4A

Consumers' System


QUÉBEC
ONTARIO
NEW YORK
MICHIGAN
GEORGIAN BAY
LAKE HURON
LAKE ONTARIO
LAKE ERIE
NORTH BAY
PETAWAWA
PEMBROKE
COBDEN
RENFREW
ARNPRIOR
HULL
GATINEAU
OTTAWA
L'ORIGNAL
HAWKESBURY
VANKLEEK HILL
ALEXANDRIA
SUMMERSTOWN
ALMONTE
CARLETON PLACE
PERTH
SMITHS FALLS
BROCKVILLE
POTSDAM
CANTON
PENETANGUISHENE
COLLINGWO
BEAVERTON
KESWI
LINDSAY
PETERBOROUGH
HAVELOC
CAMPBELLFORD
PORT PERRY
SHELBURNE
ORANGEVILLE
BOLTON
HILLSBURGH
BRAMPTON
AJAX
WHITBY
OSHAWA
BOWMANVILLE
METROPOLITAN TORONTO
ST. CATHARINES
GRIMSBY
WELLAND
PORT COLBORNE
NIAGARA FALLS
FORT ERIE
STORAGE
TECUMSEH STORAGE
UNION STORAGE
LEGEND
The Consumers' Gas Company Ltd.
Metro Region
Central Region (East Central)
Central Region (North Central)
Central Region (Georgian Bay)
Western Region
Provincial Gas
Ottawa Gas
Gazifère Inc
St. Lawrence Gas
Underwater Gas Developers
The Consumers' Gas Company Ltd. distribution system
TransCanada PipeLines Limited transmission facilities
Great Lakes Gas Transmission Company transmission facilities
Union Gas Limited transmission facilities
Underground storage
▲ Site of proposed Consumers Gas Liquefied Natural Gas Storage Facility

- the operation of underground gas storage facilities in Ontario; and
- contract well drilling for gas and oil in Ontario and the northeastern United States.

4.11 The company also has an extensive gas and electric appliance marketing program through a chain of retail stores, and engages in consulting and advisory services to other gas companies and governments, both in Canada and internationally.

4.12 Underground storage located in southwestern Ontario is a key component of Consumers' natural gas transmission and distribution system. Tecumseh Gas Storage Limited (Tecumseh), located in the Sarnia area, provides storage facilities for the Consumers' system. Jointly owned by Consumers' and Imperial Oil Limited, Tecumseh operates storage reservoirs with a working capacity of 1,671 10^6m^3. Additional storage capacity of up to 365 10^6m^3 is secured under long-term agreements with Union. Consumers' also operates two small underground storage reservoirs in the Niagara peninsula, Crowland and Leepfrog, which are used to meet local peak day requirements.

4.13 These three utilities together with TCPL, provide the complex network of pipelines which serve Ontario with natural gas. In the summer, this network has excess capacity in many of its segments and consequently there are alternative ways in which gas can be routed through the province, sometimes reversing the normal direction of flow. This flexibility permits each utility to undertake maintenance and construction projects during the off-peak period of the year while continuing to supply gas. In addition, gas injection into the underground storage pools of southwestern Ontario is facilitated by the ability to transport gas in two directions, in both the Union line between Dawn and Trafalgar, and various segments of the TCPL system.

4.14 As demand increases, injection of gas into the storage pools slows and then stops. Once the demand reaches the limits of the supply agreements between TCPL and the distributors, gas begins to flow into the distribution system from the underground storage pools. On peak demand days, the ability of TCPL and the storage pools to meet the demand approaches their limit.

4.15 At such times, any failure of a pipeline, compressor or valve may threaten significant portions of a utility's customer base. Admittedly, serious failures have been very rare. When they have occurred, all suppliers who had gas available cooperated to deliver it to those affected.

4.16 A key element of security of supply at such times is the underground storage in southwestern Ontario. Without that storage, a serious system failure anywhere west of TCPL's delivery points in Ontario could lead to a severe gas shortage in the province within hours.

5. DEVELOPMENT OF LNG TECHNOLOGY

5.1 Interest in using LNG to meet the peak shaving and base load needs of natural gas utilities goes back many years. Peak shaving plants are designed to supply natural gas only on the coldest days of the year, when demand is greatest, or in emergency situations. Base load plants, on the other hand, are designed to liquefy natural gas on a daily or continual basis to be transported to other areas where natural gas is less plentiful.

5.2 The first facility which actually liquefied and stored LNG for later use was a pilot peak shaving plant built by the Consolidated Natural Gas System (Consolidated) in 1939 at Cornwell, West Virginia.

5.3 In 1941, the East Ohio Gas Company, a subsidiary of Consolidated, built a peak shaving plant in

Cleveland, Ohio. The storage containers consisted of three spherical tanks. The inner shell of each tank was made of 3.5 per cent nickel steel and was surrounded with granular cork insulation. The outer shells were made of carbon steel.

5.4 After two and a half years of successful operation at Cleveland, a fourth storage tank was added. The inner shell was also 3.5 per cent nickel steel and the outer, carbon steel. The supports were integrally designed to support both shells through wooden posts bearing on a concrete mat foundation. In 1944, this tank collapsed, resulting in a disastrous fire which claimed the lives of 133 people and caused extensive damage to and around the plant.

5.5 The United States Bureau of Mines Report, with respect to this accident, indicated that 3.5 per cent nickel steel used for the inner shell may not have been suitable for the tank, particularly in view of the fact that vibrational or shock loads could have been concentrated at the columns and could have been directly transmitted to the circular support of the inner shell. Since the writing of that Report, it has been established that 3.5 per cent nickel steel has low impact resistance at the service temperature of LNG.

5.6 The general conclusion of the Bureau of Mines Report was that regardless of the cause of this disaster, the application of the system for liquefying and storing quantities of natural gas was not invalidated, provided proper precautions were observed.

5.7 In 1957, the British government approved a plan for the North Thames Gas Board to begin an experimental investigation of LNG. In January, 1959, the first shipload of LNG left the United States in the Methane Pioneer, a specially reconstructed tanker ship, and was received at Canvey Island, England.

5.8 Based on the success of the experimental program, the British government in 1961, approved a plan for liquefying natural gas near Arzew, Algeria and shipping it in two tankers to Canvey Island.

5.9 The storage facilities at Canvey Island consisted of above-gound, double-walled steel tanks with aluminum inner shells. The space between the inner and outer shells was filled with powdered perlite insulation.

5.10 Following gas shortages in 1965, the British Gas Council and Area Gas Boards authorized major expansion of the storage facilities at

Canvey Island to meet peak demand during the winter months.

5.11 The first commercial LNG tank ships, the Methane Princess and Methane Progress, commenced service in 1964, carrying LNG from Algeria to England. Since 1964, more than 70 additional LNG tank ships have been constructed. The Canvey Island project, however, has been converted to a peak shaving facility. Nonetheless, as of March, 1984, there were over 60 LNG tank ships in service or available for service. In the past 20 years, 10 LNG marine export terminals and 17 marine import terminals have been built in many areas throughout the world, including the United States, Indonesia, Malaysia and Algeria.

5.12 In the late 1950's and early 1960's, with the rapid growth in natural gas sales and increases in peak shaving requirements, the North American utility industry also began looking for non-conventional ways to store natural gas close to its markets. The American Gas Association (AGA) began studying below-ground storage and insulated prestressed concrete tanks at the Institute of Gas Technology. Simultaneously, Battelle Memorial Institute began an independent but parallel investigation for Texas Eastern Transmission Corporation. The results of both of these research investigations indicated that such storage was technically feasible and led to the construction of model tanks. At about the same time, the industry began to conduct experiments on a frozen-earth pit to assess the feasibility of this method of storage. In this concept, the LNG is put in direct contact with the surrounding frozen soil or rock. This "frozen-hole" was constructed by circulating refrigerant through a circular array of freeze pipes buried vertically in the ground. When the frost boundary had been established the unfrozen centre was excavated, a vapour-tight roof was installed and the cavity filled with LNG.

5.13 In 1963, the Transcontinental Gas Pipe Line Corporation announced its plans to construct a liquefaction plant near Carlstadt, New Jersey. Storage was to be below ground in a frozen-hole. The roof was 9 per cent nickel steel and was insulated. Injection of LNG into the storage container began in October, 1965. The performance of this reservoir, however, was not satisfactory for peak shaving storage. An apparent heat leak beyond that originally calculated in the design of the reservoir precluded filling the cavity beyond 60 per cent of its design capacity. The frozen-hole was abandoned in favour of an above-ground steel tank.

5.14 Late in 1965, construction of the largest LNG peak shaving facility, at that time, was commenced by the Tennessee Gas Pipeline Company. Storage consisted of two frozen-hole, in-ground tanks. The tanks were covered by sealed, double-walled steel roofs, with the inner roof made of 9 per cent nickel steel and the outer of carbon steel. Liquefaction operations began during the summer of 1967. During the ensuing 18 months of operations, the design prediction of heat leakage was continuously exceeded by varying amounts. Due to the unsatisfactory performance of the in-ground storage units, the plant was sold and modifications were made to accommodate newly-installed above-ground metal storage tanks which were placed in commercial operation in September, 1971.

5.15 In 1964, LNG plants were built in the United States by the Alabama Gas Corporation, the San Diego Gas and Electric Company, and the Wisconsin Natural Gas Company. Storage facilities at these plants consisted of above-ground double-walled steel tanks. The inner tank was made of 9 per cent nickel steel. In 1971, a second LNG storage tank was added to the Alabama operation. These plants have all been in successful service since the beginning of their operations.

5.16 In Memphis, Tennessee, the municipally-owned and operated Memphis Light, Gas and Water Division completed the construction of an LNG peak shaving plant in the summer of 1967. Similarly, the Brooklyn Union Gas Company LNG peak shaving facility became operative in 1968. Again, in both these operations, the storage facility consisted of a double-walled insulated steel tank. The inner tanks were made of 9 per cent nickel steel while the outer shells are comprised of specific types of carbon steel.

5.17 In May, 1967, Texas Eastern Transmission Corporation began construction of LNG facilities, which included a large capacity prototype prestressed concrete storage tank, at Staten Island, New York. This tank was unique in design and had followed several years of research and development carried out by Battelle Memorial Institute. The tank was internally insulated and lined and was constructed near ground level with an earthern berm. This was not a peak shaving plant but rather a plant designed to store LNG received from seagoing vessels. The plant commenced operation in March, 1970. The tank remained in service until the spring of 1972, at which time it was emptied, purged with nitrogen, re-purged with air and entered to investigate the internal condition of the tank, conduct maintenance and make modifications. In February, 1973, while repairs were nearing completion, an electric spark or a cigarette lighter caused a fire inside the tank, creating a pressure buildup which caused the reinforced concrete roof to collapse killing over 40 workers. Reports of this accident indicate that the insulation system consisted of a flammable polyurethane foam covered by a barrier known as mylar. Apparently, the barrier was ineffective and the insulation absorbed LNG over a period of about a year.

5.18 In September, 1967, Northern and Central Gas Company Limited (now ICG) announced its intention to build an LNG peak shaving facility at Hagar, near Sudbury, Ontario. The plant has been in continuous operation since 1968. The storage tank is an above-ground double-walled steel tank. The inner tank is constructed of 9 per cent nickel steel. The outer tank is constructed of mild steel and separated from the inner tank by five feet of perlite insulation. An earthern dike surrounds the tank area and has a capacity of 1.5 times the volume of the tank. According to sources from ICG, a leaking LNG valve once allowed LNG to drip onto the auxiliary burner of one of the vapourizers causing a small fire. The fire was extinguished promptly and no injury or damage occurred other than to the vapourizer shell. To prevent a recurrence, the auxiliary burners were relocated.

5.19 In 1969, Gaz Metropolitain inc. (GMi) installed a comparable LNG facility in Montreal, Quebec and in 1972, a second tank of similar proportions was added. In late 1972, non-odourized natural gas escaped into the control room and was ignited by a cigarette causing an explosion. Apparently no injuries ensued. In 1975, however, an explosion in the compressor room caused by a faulty heating system and escaped gas caused burns to two employees.

5.20 In 1971, British Columbia Hydro and Power Authority commissioned an LNG peak shaving plant in Vancouver, B.C. It too was an above-ground, double-walled tank, the inner of which was made of 9 per cent nickel steel.

5.21 In 1974, Northern Indiana Public Service Company constructed an above-ground, double-walled LNG facility in Laporte, Indiana. In 1981, a second tank was added which is of a size similar to the tank Consumers' proposes to build.

5.22 Since 1960, numerous satellite LNG facilities have also been constructed. These facilities incorporate the storage and vapourization components but are unable to liquefy gas. In fact, in the late 1970's Consumers' built a satellite peak shaving plant at Arnprior, Ontario, to serve the peak needs of its Ottawa Valley market. LNG was transported to that plant by truck from GMi. When the North Bay Shortcut was built by TCPL, this tank became redundant and was taken out of service by Consumers'.

5.23 In the past two decades, more than 70 LNG peak shaving plants with liquefaction capability have been built worldwide, approximately 50 in the United States and three in Canada. Another 80 satellite LNG peak shaving plants have been constructed around the world.

5.24 Since the Cleveland failure in 1944, progress in LNG technology has been heavily influenced by safety considerations. A Special Code Task Group for the Storage and Handling of LNG at Utility Gas Plants was formed in the United States. This group acted in an advisory capacity to the National Fire Protection Association (NFPA) which published Bulletin 59A in 1967. This Bulletin, entitled "Standard for the Production, Storage and Handling of Liquefied Natural Gas" has had several revisions, the lastest of which is NFPA #59A-1979 (NFPA 59A).

5.25 Within Canada, LNG facilities are located, designed, constructed, and operated in conformance with Canadian Standards Association (CSA) Standard Z276-M1981, Liquefied Natural Gas (LNG) - Production, Storage, and Handling (CSA Z276).

6. THE HEARING

6.1 On October 15, 1985, Consumers' applied to the Board requesting an Order granting leave to construct two pipelines pursuant to section 46 of the Ontario Energy Board Act, (R.S.O. 1980, Chapter 332, as amended). These pipelines would transport natural gas to and from TCPL's system and the proposed LNG facility. Consumers' submitted a second application in respect of these pipelines for a certificate of public convenience and necessity to construct works to supply gas and to supply gas in the Township of Haldimand pursuant to section 8 of the Municipal Franchises Act, (R.S.O. 1980, Chapter 309, as amended). These applications have been identified as Board File Nos. E.B.L.O. 207 and E.B.C. 170, respectively.

6.2 The LNG facility itself was not the subject of an application. On January 30, 1986, the Lieutenant Governor in Council issued Order in Council No. 327/86 requiring the Board to:

> ... examine and, after holding a public hearing with respect thereto, report to the Lieutenant Governor in Council on whether the project is in the public interest and in making this determination, the Board shall take into account all such matters as to it appear to be relevant, and without limiting the generality of the foregoing, the Board shall have regard to the following:
>
> 1. the need for the Project;
> 2. the alternatives to the Project which will satisfy that need;
> 3. the safety considerations associated with the Project;
> 4. the advantages and disadvantages of the Project, the alternatives to the Project and the six candidate sites considered by the applicant, taking into account the physical, social, economic, cultural and natural environment, including effects on air, land and water; and
> 5. the economic feasibility of the Project.

6.3 This reference from the Lieutenant Governor in Council was made under section 36 of the Ontario Energy Board Act, which provides an opportunity for public participation in circumstances where the proposed works are a matter of public concern. The reference has been identified as Board File No. E.B.R.L.G. 29.

6.4 A few days later, on February 7, 1986, a second Order in Council No. 366/86, appointed Mary G. Munro to the OEB. Mrs. Munro is a Vice-Chairman of the Environmental Assessment Board and her inclusion on the panel gave the Board the benefit of her knowledge and experience in environmental matters.

6.5 On February 21, 1986, Consumers' was instructed to publish the Board's Notice of Reference and Applications and Notice of Hearing. To facilitate public participation, it was decided that the hearing would be held at the Lions Club Centre in Cobourg, Ontario.

6.6 The Board issued a Procedural Order dated March 27, 1986. The Order stated that the hearing would commence on April 30, 1986, and that the Board would hear two preliminary motions, which had been brought on behalf of certain intervenors, on April 7, 1986, in Cobourg.

6.7 The first motion heard was brought on behalf of the Concerned Citizens Against LNG-Cramahe, seeking a ruling that the OEB could approve only the specific site in Haldimand Township, which is the subject of the proposal before the Board, and no other site. At the hearing this motion was expanded somewhat to include "recommend approval", as well as "approve", in the requested ruling.

6.8 On April 14, 1986, the Board issued its written ruling on this motion in which it said:

> The Board rules that neither s.46 of the Ontario Energy Board Act, s.8 of the Municipal Franchises Act nor Order in Council 327/86 confer jurisdiction upon it to approve a site for the location of the LNG Project other than that identified as Haldimand-3. The Board, however, is unable to accept that the Order in Council prohibits it from recommending approval of an alternative site.

6.9 In effect, the Board said that while it could not approve any site, proposed or otherwise, it could not agree that it was prohibited from recommending approval.

6.10 The second motion heard was brought on behalf of the Concerned Citizens of Haldimand Township (the CCH) a group of sixteen ratepayers from Haldimand Township. In this motion, the Board was asked to adjourn the proceedings. Counsel for the group informed the Board that his clients had applied to the National Energy Board (the NEB) for a determination that only the NEB has jurisdiction to hear the LNG proposal. He then argued that the constitutional question, inherent in the application to the NEB, ought to be resolved before the OEB proceeded any further with the matter. In its written ruling, also issued on April 14, 1986, the Board denied this motion saying:

> The Board denies this application for an order adjourning these proceedings.
>
> The Board is of the opinion that on balance it would be just and convenient to continue as planned with the applications by Consumers'.
>
> Moreover, Order in Council No. 327/86 instrumentally establishes the Board's jurisdiction in respect of the LNG Project and requires the Board to hold a public hearing.
>
> The Board therefore rules that it will proceed with the matters before it as scheduled, on Wednesday, April 30, 1986.

6.11 The hearing began on April 30, 1986, and continued until May 30, 1986, at which time it was adjourned to enable the Board to conduct its annual review of Ontario Hydro rates as required by the Minister of Energy. The hearing reconvened on July 14, 1986, and was completed on August 25, 1986.

6.12 On August 18, 1986, Procedural Order No. 2 was issued to define the order, manner and form of written argument. All written argument was submitted by October 10, 1986. There were forty-one volumes of transcript which contain 6,889 pages.

Appearances

6.13 The following persons appeared before the Board and actively participated during the course of the hearing, either on their own behalf or as the representative of an organization or individual:

D.H. Rogers, Q.C. J.D. Strung	Special Counsel on behalf of Board staff
P.Y. Atkinson F.D. Cass	The Consumers' Gas Company Ltd.
J.B. Jolley, Q.C.	Union Gas Limited
C.C. Black M. Brown	TransCanada PipeLines Limited
J.S. Herron	Township of Haldimand
J.R. Tidball	The Ministry of the Environment
I.A. Blue, Q.C. B.A. Harris G. Hinton	Concerned Citizens of Haldimand Township
L.J. Forbes	on behalf of herself
L.F. Balint	on behalf of himself

6.14 An evening session was held on July 29, 1986, during the Design and Safety phase of the hearing, to permit members of the public and intervenors unable to attend the proceedings during the day to ask questions of the witnesses called by Board staff. Those attending this session were also welcome to give opinions and state concerns. The following is a list of those who appeared:

Members of the Public

E. Dequehen
G. Rogers
B. Quarrington
L. McIlroy
P. Marston
S. Johnston

Intervenors

K. Savage
P.G. Tunney
D. Chambers
R. Giles
B. Tunney

6.15 The following parties intervened in the proceedings on their own behalf but did not actively participate in either the daily or evening sessions:

E.A. Chambers
W.F. Dix
D. Innis
A. Loughlin
H. Loughlin
R. Loughlin
T. Loughlin, Jr.
D.E. Ripley
R. Savage
U. and H. Stein
D. Tollan
P.J. Tunney

6.16 The following intervened in the proceedings on behalf of another party but did not actively participate in either the daily or evening sessions:

H. Dahme	Concerned Citizens Against LNG - Cramahe
D.I. Poch	Energy Probe
R. DeWolf	Independent Petroleum Association of Canada
E.G. Sheasby	Interprovincial Pipe Line Limited
R. Lightbody	on behalf of K.E. and M. Larkin
W. Blake	Natural Resource Gas Limited
G. Laidlaw	Northern and Central Gas Corporation Limited (now ICG Utilities (Ontario) Ltd)
C.S. Stevenson, Q.C.	Ontario Hydro

6.17 A second evening session was held on August 14, 1986, for the presentation of evidence by those intervenors unable to attend the proceedings at regularly scheduled times. The following came forward to give testimony:

Citizens for Progress and Development in Haldimand

J.R. Giles
P. Greydanus

S. Johnston
J. Chalovich
W. Finley

Toronto Central Ontario Building and Construction Trades Council

J. Kurchak
O. Begg
B. Christie
T. Kelsey

Concerned Citizens of Haldimand Township

L.J. Forbes
M. Hinton
K. Savage
T. Loughlin

Intervenors Appearing on their own behalf

N.A. Baird
O. James
J. Innis
D. Pritchard

6.18 Although not a registered intervenor, one individual came forward and gave testimony on the danger he perceived his family's campground (Shelter Valley Trailer Park) had been placed under, due to its proximity to the proposed site:

S.J. Sawyer

Witnesses

6.19 The following is a list of all the witnesses who gave evidence before the Board in each of the five phases of the hearing and for whom they appeared:

Phase I - Need

Consumers'

R.G. Riedl	Director, Gas Supply
W.B. Taylor	Director, Financial and Economic Studies
J.R. Hamilton	Assistant to Vice President, Marketing
M. Mitchell	Senior Vice President, Stone and Webster Canada Ltd.

Board Staff

Leo de Bever	Director, Chase Econometrics Canada

TCPL

B.M. Otis	Senior Manager, Transportation
M. Feldman	Manager, Facilities Planning

Phase II - Alternatives

Consumers'

R.G. Riedl	
W.B. Taylor	
J.D. Drysdale	Senior Engineer, Gas Supply Planning
D.M. Kent	Manager, Engineering Services

R.J. Craig	Manager, Exploration
M. Mitchell	

Union

B.J. Kemble	Manager, Engineering
W.G. James	Manager, Facilities Planning
P.D. Pastirik	Manager, Financial Studies
G.D. Black	Manager, Gas Supply
W. Andrewes	Supervisor, Cost of Service Studies

Board Staff

R.T. Liddle	President, Liddle Engineering Ltd.

Phase III - Design and Safety

Consumers'

R. Riedl	
A.J. Pleckaitis	Project Engineering Manager
J.H. Alton	Project Engineer
L.E. Brown	President and Senior Consulting Engineer, Energy Analysts, Inc.
L.F. Litzinger	Senior Process Consultant, Litzinger and Co. Engineers

Board Staff

G.F.I. Roberts	Associate, Environmental Resources Limited
D.H. Napier	Director, Chemical Engineering Research Consultants Limited
E. Grzesik	Chief Engineer, Fuels Safety Branch, Ministry of Consumer and Commercial Relations
H.J. Wright	Director and Chief Inspector, Pressure Vessels Safety Branch, Ministry of Consumer and Commercial Relations

Ministry of the Environment

P.K. Misra	Supervisor, Atmospheric Model Development Unit, Air Quality and Meteorology Section

Intervenor

L.F. Balint	Evidence on his own behalf

Phase IV - Site Selection and Environment

Consumers'

R.G. Riedl	
A.J. Pleckaitis	
G.M. Bolubash	Environmental Planner
D. Lawrence	Director of Public Affairs, Research and Planning

D.M. Gorber	President and Director, Environmental Impact Assessment Studies, SENES Consultants Limited
A.W. Keir	Manager, Economic Planning Division, Giffels Associates Limited
D.W. Reades	Principal, Golder Associates
G.M. Atkinson	Engineering Seismologist, Acres International Limited
E. Koczkur	Chairman and Director for Air Environment Studies, SENES Consultants Limited
D. Stone	Consulting Environmental Scientist and Special Consultant to SENES Consultants Limited
T.A. McIelwain	Hydrogeologist, Golder Associates
R.J. Leech	Principal, Gartner Lee Associates Limited
E. Muller	Principal, Terra Geographical Studies, Inc.
M.K. Hoffman	Soil Scientist and Vice-President, Smith, Hoffman Associates Ltd.
C.N. Watson	Principal, C.N. Watson and Associates Ltd.
D.A. Griffiths	Vice President, Casualty Marketing Manager, Reed Stenhouse Limited

L.T. Long	Vice President, Technical Services, Reed Stenhouse Limited

Ministry of the Environment

R. Ramakrishnan	Project Analyst, Acoustics, Noise Assessment Unit, Environmental Approvals and Land Use Planning Branch

Township of Haldimand

P.R. Walker	Principal, Walker, Wright, Young Associates Limited

Concerned Citizens of Haldimand Township

G.T. Hinton	Chairman
W.F. Dix	Member

Union

R.R. Bryant	Senior Pipeline Engineer
I. Moncrieff	Environmental Planner
C.M. Kitchen	Principal, Ecoplans Ltd.
E.E. Mackintosh	President, Ecological Services Planning Ltd.

Phase V - Pipeline Facilities

Consumers'

G.M. Bolubash

D.M. Kent	
J.H. Alton	
C.R. Smith	Vice President, Smith, Hoffman Associates Ltd.

6.20 A verbatim transcript of the proceedings and all exhibits are available for public review at the Board's offices.

The Stated Case

6.21 On August 11, 1986, based on the evidence established in respect of the project in the course of the hearing, the Board notified all parties that it intended to state a case to the Divisional Court on its constitutional authority to issue a report further to the Order in Council and on its authority to rule on the two applications filed by Consumers'. The Board was of the view that the jurisdiction of the Lieutenant Governor in Council to make the reference and the jurisdiction of the Board to deal with the applications had to be confirmed, particularly in light of the constitutional issue originally raised by the CCH.

6.22 The Board invited all parties to submit, in writing, by August 15, 1986, their brief opinions and positions respecting the facts that ought to comprise the background to the stated case and the phrasing of the question or questions of law that ought to be put to the Divisional Court. Written submissions were received from Consumers', Union, ICG, the CCH and Special Counsel.

6.23 The stated case requested the opinion of the Divisional Court on the following questions:

(1) Does the Ontario Energy Board have jurisdiction to issue an order granting leave to construct two natural gas transmission pipelines pursuant to section 46 of the Ontario Energy Board Act, as requested by The Consumers' Gas Company Ltd. in its application of October 15, 1985?

(2) Does the Ontario Energy Board have jurisdiction to grant a certificate of public convenience and necessity to construct works to supply gas and to supply gas, pursuant to section 8 of the Municipal Franchises Act, as requested by The Consumers' Gas Company Ltd. in its application of October 15, 1985?

(3) Does the Ontario Energy Board have jurisdiction, as required by the Lieutenant Governor in Council by Order in Council 327/86 issued pursuant to section 36 of the Ontario Energy Board Act dated January 30, 1986 to:

(a) hold a public hearing with respect to the Project;

(b) report to the Lieutenant Governor in Council on whether the Project is in the public interest?

6.24 The stated case was filed with the Divisional Court on September 22, 1986, and was heard on October 20 and 21, 1986.

6.25 On November 10, 1986, the Divisional Court released its decision in which it answered all three questions in the affirmative.

7. PUBLIC PARTICIPATION

7.1 In order to facilitate public participation, the Board undertook a number of measures to ensure that the public understood the hearing process, the procedures for participation, the issues to be examined and the organization of evidence. In addition, the Board directed a great deal of effort towards making participation convenient to those members of the public most directly affected by the proposal.

7.2 Since the applications and reference aroused the interest of many residents and landowners in the vicinity of the site selected in Haldimand Township, the Board was of the view that if it were to hold the hearing at its offices in Toronto, the important participation of these parties would be effectively prohibited. The Board, therefore, chose to hold the hearing at the Cobourg Lions Club Centre, about 15 km from the proposed site.

7.3 Consumers' was also acutely aware of the value of public participation. Consequently, the company conducted an extensive public participation program in an attempt to both inform the public about the proposal and ideally to achieve an informed consent. Although all members of the public were not persuaded by Consumers' to support the proposal, its program was, at the very least, successful in stimulating public participation throughout the development of the proposal and the hearing.

7.4 The local media also encouraged public participation by their daily reporting of the proceedings. In addition to a fair analysis of each phase of the hearing, the local newspapers interviewed many of the hearing participants and published the positions of parties both in support of, and in opposition to, the proposal. The Board placed various advertisements in local newspapers and on local radio stations.

7.5 The following summary outlines the efforts of the Board, and of Consumers', to facilitate public participation. Although this summary does not include each meeting or discussion between Board staff, Consumers' and the public, it does highlight the more formal attempts to ensure public participation.

Ontario Energy Board

7.6 The Board's Notice of Reference and Applications and Notice of Hearing were published in the Ontario Gazette and five newspapers; they were also sent to the clerks of sixteen municipalities in the area of the proposed facility and any railways and utilities whose lands might be crossed by the proposed pipelines. In addition, copies were sent to the ministries of Natural Resources, Agriculture and Food, the Environment, Transportation and Communications, Consumer and Commercial Relations, plus the Ontario Federation of Agriculture and the Environmental Assessment Board. Two hundred and twelve private citizens and interested organizations also received the notices.

7.7 In March, Board staff met with two citizens groups to outline the interrogatory and hearing processes and to instruct them as to how to participate.

7.8 Pursuant to the Notice of Reference and Applications and Notice of Hearing, the Board indicated that the hearing would commence on Wednesday, April 30, 1986, and that a pre-hearing conference would be held in Cobourg on Tuesday, March 25, 1986. At the pre-hearing conference, the Board outlined the procedures it proposed to follow in the hearing and solicited comments on these procedures.

7.9 The Procedural Order issued on March 27, 1986, reflected input received at the prehearing conference and contained instructions on how to intervene, file evidence and participate.

7.10 On April 29, 1986, a public information trailer was opened by the Board on the grounds of the Cobourg Lions Club Centre. The trailer was staffed with an information officer and remained open throughout the hearing. The trailer contained copies of all evidence and verbatim transcripts of the proceeding. In addition, a hearing schedule was provided to the public on a daily basis. A photocopier was provided for copying evidence and a sign-out procedure was established to enable participants and the public to review material overnight.

7.11 Dates for filing of evidence by local intervenors were extended by the Board for those unable to meet previously established deadlines.

7.12 The Board conducted evening sessions of the hearing to allow input from members of the public and intervenors unable to attend during the day. Evening hearings were held July 29, August 14, and August 18, 1986.

7.13 Between September 17th and 19th, secretarial services were provided by the Board, in Cobourg, for the typing of arguments for intervenors who appeared on their own behalf.

Consumers'

7.14 During the course of the site selection and environmental assessment processes, Consumers' conducted a four stage public participation program. The fundamental goal of the program was the systematic development of informed consent for the LNG project among the public which included, not only the general public, but also landowners, neighbours, area residents, the media and elected officials.

7.15 Stage 1 of the process extended from March, 1985, when the project was announced, to June of that year. Meetings were held with the councils of the local municipalities and a public information centre was established in Castleton, Ontario, for two days in April. Approximately 500 people attended the centre, where information about the project was given out and comment forms were distributed. Approximately 175 forms were returned, reflecting the concerns of the public which emphasized safety, environmental, financial and economic issues.

7.16 Stage 2 of the process extended from June to August, 1985. An information package was mailed to each household in Haldimand, Cramahe and Brighton Townships on June 17th, and as a result, approximately 372 people requested further information. At the same time, the project was advertised in the local and regional newspapers. On June 26, after Haldimand-3 had been announced as the preferred site, a project information centre was established in the Village of Colborne, which was open to the public five days a week. An information centre was also held for two days at the public school in Colborne and was visited by approximately 227 people. Again, several comment forms were returned by members of the public and analyzed by the consultants. The concerns expressed centred on the issues of safety, noise, aesthetics, air quality and municipal finance.

7.17 Stage 3 of the public participation program was conducted from September to early November and incorporated the detailed environmental assessment of the Haldimand-3 site. During this period, eight persons from the Haldimand area were taken on a tour of the Northern Indiana Public Service Company LNG plant (the Laporte facility) near Laporte, Indiana. In addition, property owners within 2 km of the Haldimand-3 site were interviewed and Consumers' attempted to resolve their concerns. The public information office was moved to Grafton and an open house was held on October 29th and 30th. Business opportunity seminars were conducted during the last week of October and the first week of November to inform local businesses of the potential opportunities associated with the project. During Stage 3, meetings were also held with Haldimand Township Council.

7.18 Stage 4 took place after the Leave to Construct and Certificate applications had been filed with the OEB, and continued until the commencement of the hearing. During this stage, Consumers' attempted to resolve some of the concerns of the public. It agreed to lower the height of the tank by 10 metres, from 50 metres to 40 metres, and to try to eliminate all views of the tank within 2 km by means of on-site and off-site landscaping. Newspaper advertising of the project was again conducted in February, 1986.

7.19 In November, 1985, and February, 1986, there were two public meetings of the Haldimand Township Council with respect to the Official Plan and Zoning By-law amendments. After the first of these meetings, a group of citizens supporting the project, the Citizens for Progress and Development in Haldimand, was established.

7.20 Ms. Lawrence and Mr. Keir, on behalf of Consumers', visited the Laporte facility in Indiana and interviewed local officials, businessmen and residents living near the facility. This trip was an attempt to discern the attitudes of people living near an LNG facility. Mr. Keir reported that most of the 18 people interviewed had relatively few concerns with the plant. Property values did not appear to have declined and there were no records of complaints to local officials.

7.21 In Mr. Keir's opinion, the public participation program was successful in that the local municipal council had approved the Official Plan and Zoning By-law amendments and a Development Agreement had been successfully negotiated. In addition, Consumers' had made changes to the project plans to accommodate, as much as possible, the citizens' concerns for visibility. The citizens' concerns had also influenced the project with respect to the proposed monitoring program for local wells and for noise containment. Also, if the facility is approved, Consumers' has agreed to meet with four families who are the owners of property in close proximity to the site, within two months of the date of the approval, to discuss their concerns relative to property values and to report back to the Haldimand Council.

7.22 Mr. Keir also stated that Consumers' believed the program had successfully achieved the informed consent of a majority of the residents of the Township.

8. THE NEED FOR FACILITIES

Introduction

8.1 In assessing the need for facilities, it is important to determine not only the future demand for natural gas but also the best method to meet that demand. This requires a determination of the magnitude and duration of demand during the peak period.

8.2 A preliminary analysis of the trends and patterns of the demand for natural gas within Consumers' system, in 1982, showed that the rate of growth of peak day sendout exceeded the rate of growth of average daily sendout. Consequently, Consumers' submitted, its load factor was deteriorating and the company was developing a "needle peaking" characteristic. The company determined that this problem could not be remedied by the use of traditional supply sources and that a less conventional solution was required.

8.3 On that basis, Consumers' set up a Gas Supply Task Force to study the expected growth in peak day requirements and to propose alternative methods of meeting it. In January, 1983, the Task Force reported that a need existed for a "peak shaving" facility, and that an LNG plant was the best solution.

8.4 In June, 1983, Consumers' retained Stone and Webster Canada Ltd. (Stone and Webster) to review the Task Force report. Following the Stone and Webster critique, Consumers' initiated a Gas Supply and Demand Study (GSDS) to establish a methodology to forecast demand, to assess the potential shortfall in peak day gas supply over the period 1984 to 1994, and to examine alternative ways of meeting the demand. The GSDS was completed late in the summer of 1984.

8.5 The basic objective of the study was to examine trends in gas demand for the past ten years by market sector and to develop a forecast of the annual, monthly, daily and peak day demands for the next ten years.

8.6 The GSDS team developed an econometric model which forecasted sendout volumes. The model contained terms for three economic factors:

growth in Gross National Product (GNP); rate of inflation; and interest rates.

8.7 These three factors were given values which were representative of four economic scenarios which Consumers' called "Base", "Pessimistic", "Optimistic" and "Base with Energy Tax Reduction" (ETR). The values given to the economic variables and the resulting projections of sendout and growth rate are shown in Table 8.1.

Table 8.1

Consumers' Annual Sendout Projections For Ontario and Quebec

Scenario	Average GNP Real Growth Projection to 1994	Inflation	Interest Rates	Approximate Total Sendout Growth to 1994	Annual Volume Compound Growth Rate
	(% per year)			($10^6 m^3$)	(%)
Pessimistic	2	Rising	High	150	0.2
Base	3-4	Stable	Stable	800	0.9
Optimistic	over 4	Low	Declining	1,400	1.5
ETR	3-4	Stable	Stable	1,900	2.0

8.8 In conducting this forecast, Consumers' employed a concept known as the degree day celsius (DDC) which assumes that when the outside temperature falls below 18°C, there will be a demand for gas for space heating. The DDC is an expression of the difference between 18°C and the average outside temperature on each day. That is, if the outside temperature on any given day is 10°C, the difference of 8°C contributes 8 degree days to the estimate of coldness of the weather, which equates to a specific estimate of gas demand. Therefore, the colder the weather, the higher the DDC condition and the higher the demand for gas.

8.9 The GSDS team analyzed temperature data over a 36 year period to develop a typical year and determined that the average of the peak days was a 37 DDC condition.

8.10 Consumers' submitted that it had used a 39 DDC condition in forecasting future demands on its system. The evidence indicated that a peak of this magnitude would occur once in 4 years.

8.11 The annual sales forecasts to 1994 were derived from the econometric model and segregated into seasonal and daily volumes. This activity generated load occurrence and load duration curves which Consumers' considered probable for the next ten years. The peak requirements under the 39 DDC condition to 1994 for the

Pessimistic scenario with normal weather was forecast to be 64.5 10^6m^3, while the Base, Optimistic and ETR scenarios raised the levels to 69.2, 73.1 and 76.5 10^6m^3, respectively.

8.12 Consumers' submitted that the Base scenario did not predict 1985 sendout with acceptable accuracy. It concluded that because of falling oil and gas prices the volumes derived from the Optimistic scenario were likely to be more representative of future growth even though the model does not deal explicitly with prices. This led the GSDS team to conclude that average annual volume growth to 1994 would be approximately 1.5 per cent, a figure that was later generally confirmed by Dr. de Bever of Chase Econometrics Canada. The GSDS team also concluded that average peak day growth would be 1.47 per cent per year. As a result, both annual and peak day demand are forecast to grow at essentially the same rate.

8.13 The projected growth in the absolute level of annual peak day demand led Consumers' to estimate that system peak day demand would increase by approximately 8,500 10^3m^3, while annual demand would increase by 1,229 10^6m^3 by 1994.

Assessment of Forecast

Consumers' Load Factor

8.14 In support of its contention that its load factor was deteriorating and that it was developing a needle peaking characteristic, Consumers' submitted that between 1977 and 1982, its average peak day sendout grew at a rate of 4.7 per cent per year while its average daily sendout increased at a rate of only 2.5 per cent per year. Furthermore, it submitted that the situation had been aggravated by the fact that the temperature sensitive portion of its market increased from 50 per cent in 1975 to 64 per cent in 1984 while the industrial or non-temperature sensitive portion decreased from 50 per cent to 36 per cent over the same time period.

8.15 Upon cross-examination by Special Counsel, it became apparent that these sendout figures were not based on normalized data and that the differences in demand may, therefore, simply be a function of abnormal weather in the years analyzed. Using normalized data, Special Counsel submitted, Consumers' would actually have experienced an average growth in peak day sendout of only 1.6 per cent between 1977 and 1982. Moreover, he suggested that the computation of the average annual growth rate is very dependent upon the time frame and starting point. If Consumers' chose to measure this rate between 1979 and 1984, he submitted, the figures would demonstrate that the company's load factor has in fact improved over that time.

8.16 Special Counsel argued that to determine the trend in peak day and annual sendout, it would be more appropriate to fit a trend line through data using linear regression analysis. This is a methodology which defines a straight line having the least error of any straight line which might be drawn through the data.

8.17 Using this method, he submitted, the average annual rates of growth were 2.3 per cent for peak day sendout and 2.7 per cent for total potential annual sendout, between 1977 and 1985. These figures substantiate his assertion that the load factor has improved over that time period.

8.18 Special Counsel submitted that the overall impression that the load factor was deteriorating from a rapid expansion in the temperature sensitive portion of Consumers' market is not borne out by the normalized historical data collected by the company.

Forecast of Annual Demand

8.19 One way of assessing the accuracy of the econometric model to forecast future demand is to measure its historic performance. Upon comparing the forecast and actual volumes for the Base scenario, however, Special Counsel submitted that, while the model was relatively accurate in forecasting annual sendout for the residential and commercial market, it underestimated actual industrial sendout by 6.8 per cent and 11.1 per cent in 1984 and 1985, respectively.

8.20 Furthermore, he submitted, in just two years Consumers' has adjusted its forecast of annual industrial sales to increase 24 per cent above that originally estimated in its 1994 Base scenario. These figures illustrated the relative sensitivity to the price of alternative fuels of the industrial market compared to the residential market.

8.21 Although Consumers' replied that the increased industrial sales were the result of an upturn in the economy that was not accurately anticipated by even the most sophisticated analysts, Special Counsel maintained that the magnitude of the errors instills little confidence in the forecast of industrial sales. He cautioned the Board to consider the implications on the

Consumers' system if substantially greater industrial demand were to occur over the forecast horizon.

Forecast of Peak Demand

8.22 Forecasts of peak demand are necessary for determining the optimal mix of future gas supplies. In order to determine demand levels during peak periods, Consumers' developed load curves using a trend analysis of the shares of heating load in each month. These were then divided into daily loads using the volumes consumed on each degree day. The daily non-heating portion of the load was then added to the daily heating loads. Company witnesses testified that forecasting peak day sendout is a much more complicated and difficult task than forecasting annual demands.

8.23 Special Counsel submitted that upon comparing actual and forecast volumes, Consumers' data revealed an average error of 2.4 per cent in peak day demand from 1984 to 1986. Moreover, a comparison of the actual and forecast peaks for 1984 revealed that Consumers' overestimated the magnitude of every one of 10 representative peak days by, in some cases, as much as 8 per cent, and that the average error in peak day forecasts was about 5 per cent, less than one year out.

8.24 Consumers' stated that such an error was not significant and that it would be more concerned if the model had predicted volumes below the actual transactions. It submitted that the average difference from 1984 to 1986 was 1.26 per cent above the forecast. The company submitted that it was 95 per cent certain that the peak day sendout in 1994 would lie entirely above the Base scenario volume of 69.2 10^6m^3 for the peak day.

8.25 Special Counsel contended, however, that errors that are consistently in the same direction may point to a fundamental problem in the model. He cautioned the Board to consider whether the impact of conservation as well as the use of high-efficiency furnaces and electric heat pumps had been adequately reflected in the company's analysis.

8.26 Moreover, Consumers' contended that it experiences lower growth in the summer and higher growth in the shoulder and winter months, which creates a steeper load duration curve. Special Counsel argued that a comparison of the forecast of total potential sendout by season for 1984 and 1994 revealed an almost identical annual rate of growth for all three periods. Consequently, he argued, if the load duration curve in 1994 is expected to have the same shape as it has at the present time, the Board should question why the same mix of natural gas sources used to meet the present need cannot economically serve future gas demands.

8.27 In reply, Consumers' relied upon the evidence of TCPL, which indicated that WPS will not be available in the coming years at the same levels as in the past. Consumers' submitted that the Board should take this likelihood into account in assessing the company's need for additional peak day supplies.

Design Degree Day Analysis

8.28 The choice of design degree day criteria for planning purposes affects the need for facilities and the analysis of alternatives.

8.29 Consumers' submitted that its present design degree day level is very low in comparison to that of other Canadian and American gas utilities. Mr. Mitchell of Stone and Webster indicated that the design of American facilities is based on the coldest day to occur once in a 10 to 30 year period. Consumers' submitted that other Canadian utilities provide for the coldest day occurring once in 31 to 37 years.

8.30 Special Counsel contended that the figures from other utilities provided by Mr. Mitchell are not comparable to those used by Consumers' because they do not indicate the frequency of occurrence of the coldest day. Furthermore, he indicated that the coldest day in the past 36 years, based on the weather data used by Consumers', demonstrated a 41 DDC condition. Therefore, Consumers' is no less conservative than any other utility in this regard. He added that Consumers' may be even more conservative in that it does not commit all of its potential interruptible load during the planning process.

8.31 Consumers' replied that this assertion overlooks the level of curtailment associated with the cold weather test. While it uses a 39 DDC condition and 2,800 10^3m^3 of daily curtailment for planning purposes, it submitted that the cold weather test assumed a 41.5 DDC condition and curtailment of 5,600 10^3m^3 per day.

8.32 Consumers' added that while it is true that the coldest weather experienced in Toronto over the last 36 years was a 41 DDC condition, the probability of this event occurring or being exceeded is once in 9 years, while its design basis of a 39 DDC condition has a probability of once in 4 years.

8.33 The company submitted that the Board should reject the notion that its design degree day level is too high and bear in mind that if the company were to underestimate the demand on its system, its ability to supply firm customers on peak days could be jeopardized. In any event, Consumers submitted that if it was to overestimate its requirements it would simply mean that additional peaking capacity would be in place a year or two before it was needed. Even in that situation, it submitted, the facility would be utilized to reduce curtailment and increase gas sales for the benefit of all Consumers' customers.

8.34 Special Counsel cautioned that the choice of design DDC condition affects both the need for the facilities and the analysis of the alternative ways of meeting that need. He submitted that the most economical alternative could differ if an average year were used as the basis for selection. He argued that because each of the alternative peaking facilities would be utilized in excess of the average rate of operation in a year with a 39 DDC condition, the economic evaluation is biased in favour of a more capital-intensive alternative (the LNG facility) and against those with higher operating costs (propane-air facilities or purchases from TCPL).

Demand Management

8.35 As mentioned above, one method of managing peak day demand used by Consumers' is the curtailment of the supply of gas to its interruptible customers. These customers are generally equipped to operate with alternate fuels.

8.36 The total theoretical curtailable load based on the present contracts is 9,915 10^3m^3 per day. Consumers' has over 1,000 interruptible customers, but only those contracting for very large volumes, who could curtail on relatively short notice, would assist in decreasing the load on peak day. In fact, Consumers' indicated that by curtailing fifty of those customers, 50 per cent of the entire contract interruptible volumes could be utilized. The principal difficulty in curtailing the remaining 50 per cent, Consumers' submitted, is that the piping changes necessary for switching fuels require the services of certified gas fitters and their availability can be a problem.

8.37 Consequently, it submitted, some interruptible customers are useful for load management only in a seasonal context where notice periods are several days or weeks. They are not directly helpful in managing peak day demands where the notice period is usually only a matter of hours.

8.38 Consumers' has generally operated on the basis of a planned curtailment of 1 per cent of annual sendout, although the actual experience in the years 1984 to 1986 was closer to 0.5 per cent. The forecasted peak day curtailment for 1984 to 1985 was 5,014 10^3m^3. If the LNG alternative is accepted, Consumers' proposes to reduce this level to 2,800 10^3m^3 in the early years of operation, but by 1994, because of increased demand, the levels of curtailment may be higher.

8.39 During the hearing, Consumers' witnesses placed considerable emphasis on the gas supply crisis in February, 1980, which resulted from a valve failure at the Princess Gate Station of NOVA at Empress, Alberta. During this failure, Consumers' curtailed 6,416.3 10^3m^3 and came very close to interrupting gas supply to its firm customers. The evidence showed that Consumers' curtailment due to weather conditions alone, however, was only 2,453 10^3m^3 during the Princess Gate failure.

8.40 Special Counsel suggested that Consumers' ought to have engaged in a more aggressive program to induce firm customers to enter into interruptible contracts and thereby enable the company to meet the peak day demand forecasts without the construction of additional facilities.

8.41 Consumers' submitted that the annual revenue shift resulting from such a campaign to increase interruptible load would exceed the cost of service of the LNG facility alone.

8.42 Special Counsel maintained, however, that if the company had explored the alternative of demand management more aggressively and reviewed the economic variables involved more closely, the Board would have a better idea of the amount of peak growth that could be mitigated by this means. He added that while demand management would not solve the entire peak day supply problem, it might reduce the additional capacity required or postpone the need for additional facilities. As a result, he submitted, the economic comparisons of the alternative ways of meeting the need may be significantly affected by this omission.

8.43 Consumers' replied that it had carefully assessed the viability of demand management and had determined that it would be inadequate in the present circumstances. It submitted that the Board should reject the judgment of experienced management only if it has been based on erroneous data.

Findings and Recommendations

8.44 Given the timing of this proposal, the forecast of the future demand must, by necessity, be made in an extremely uncertain environment. Uncertainties regarding the price of natural gas resulting from the Agreement on Natural Gas Markets and Prices, the relative price of oil and the rate of conservation in the face of lower natural gas prices all contribute to the difficulty in forecasting natural gas sales. While forecasting annual demand may prove difficult in the face of these uncertainties, forecasting peak day demand is substantially harder. Consequently, forecasts of peak day demand ten years into the future are very speculative.

8.45 The Board is of the view that the normalized data do not support Consumers' contentions that its load factor is deteriorating and that it is developing a needle peaking characteristic. Moreover, it is clear that while the company's temperature sensitive market has increased, the effect appears to have been offset to some degree by conservation and other factors. The Board accepts that the figures advanced by Special Counsel are reliable and that, based on the results of the linear regression analysis, Consumers' load factor has actually improved over the period 1977 to 1985.

8.46 The Board is of the view that Consumers' has implicitly employed a 41 DDC condition for facilities planning purposes in this instance. The demand forecasts have been determined on the basis of weather conditions which are likely to occur much less frequently than indicated by the company.

8.47 The Board is of the view that the company's annual demand is increasing at an average rate of about 1.5 per cent per year, although year-to-year changes could be substantially above or below that level. A precise estimate of the forecast error cannot be made until the forecasting model has been tested for several years, without modification, against actual demand experience.

8.48 While the Board recognizes that all forecasts are subject to limitations with respect to their accuracy, the magnitude of the forecast errors identified by Special Counsel give the Board some cause for concern. If Consumers' industrial sales were to continue to exceed the forecast to the degree they have in the past two years, the load factor would continue to improve, contrary to the company's submissions.

8.49 The Board is of the view that demand management techniques have not been fully explored by the company. The Board recognizes that it is a clear advantage for a utility to construct facilities since a rate of return is earned on incurred costs. Load management techniques, on the other hand, do not earn a rate of return. Regardless of the volume of future peak day demand, the need may best be served by obtaining additional gas from underground storage together with emphasis on enhanced demand management techniques to encourage additional interruptible load.

8.50 The Board is of the view that the forecast of peak day demand has not stood up to critical analysis. While the Board finds that the forecasted peak day demand of 8,500 10^3m^3 in the period 1985 to 1994 has not been demonstrated, it is prepared to admit that, due to the complexity of the matter, it cannot state an alternative volume which would reasonably bear the test of time. Rather, contrary to the company's contentions, the forecast has consistently overestimated peak day demand and the load duration curves are not steepening. Therefore, the Board is of the opinion that Consumers' has not demonstrated that there exists a need for peak shaving facilities.

9. THE ALTERNATIVES CONSIDERED BY CONSUMERS'

Introduction

9.1 As has been established, there is considerable uncertainty about the timing, magnitude and shape of the future demand growth for natural gas. Therefore, to make an accurate comparison of alternatives it is necessary to evaluate the ability of each alternative, or combination of alternatives, to satisfy Consumers' perceived need of 8,500 10^3m^3 per day for approximately seven days in a year.

9.2 In addition, the various alternatives must be compared on the basis of cost, security and diversity of supply, system reliability and flexibility. Once Consumers' had identified the future need for additional gas supplies between 1984 and 1994, it determined that a combination of engineering options would be necessary. It identified a need for new facilities and pipeline supplies in order to achieve a satisfactory security of supply and to meet its stated objective of providing gas at the most favourable cost to its customers.

9.3 The four alternatives presented by Consumers' and reviewed were:

- to purchase additional WPS from TCPL;
- to use propane-based peak shaving facilities;
- to expand Tecumseh underground storage facilities, including increased storage and transportation by Union; and
- to construct an LNG facility.

Additional WPS from TCPL

9.4 TCPL indicated that at present, it does not have suffcient capacity in its pipeline to guarantee the provision of WPS volumes. Consumers', therefore, began an investigation, jointly with Union, by enquiring of TCPL in 1982, as to the cost of providing additional volumes up to 14,000 10^3m^3 per day of WPS. TCPL advised that this option would involve a capital expenditure of about $738 million to provide additional pipeline and compression facilities. Consumers' share of these costs would have been in the order of $480 million, estimated to be approximately five times the cost of any other alternative. Consumers' considered the cost of this alternative to be prohibitive.

Propane Alternative

9.5 The second alternative considered by Consumers' was the possibility of using propane facilities, a concept that is used in Winnipeg for providing peaking service.

9.6 Propane gas can be liquefied by applying pressure at ambient temperatures and can be kept liquid at approximately 1030 kPa (150 pounds per square inch (psi)) and can be easily stored in pressurized tanks or refrigerated.

9.7 Within the propane alternative, three supply methods were identified and analyzed:

- propane-air injection;
- pure propane injection; and
- point-of-use.

9.8 The propane-air injection method involves the mixing of 55 per cent propane with 45 per cent air to achieve a mixture with a heating value of 1,400 BTU per cubic foot (cf) and then injecting the propane mixture into the distribution system to mix with natural gas which has a heating value of approximately 1000 BTU per cf.

9.9 The propane-air injection stations would, for the most part, be located in densely populated areas and therefore, there would be noise and safety factors which would have to be considered with the installation of compression and storage facilities. Additional traffic in these areas would also be caused by tank-truck deliveries of propane.

9.10 It was determined that four feeder stations could be used in this option and the net result would be a reduction of 2,000 10^3m^3 in the peak day demand. The cost was estimated to be in the order of $20 million to provide one-quarter of the identified peak day deficiency.

9.11 The second method of using propane for peak shaving service would be by direct injection of pure propane into the natural gas stream. This method would enrich the heating value without changing the combustion characteristics of the gas and would therefore reduce the volume of gas used by the customer. Consumers' testified that in addition to customer difficulties, the direct injection option would present technical and engineering difficulties as well as administrative and rate implications.

9.12 The third and most feasible propane alternative was the point-of-use method. Large-volume, firm customers in the Consumers' system would be identified and have stand-by propane-air systems installed at their plants by Consumers'. The customers' systems would be adjusted in order that either natural gas or propane-air could be burned. Consumers' would control the switch-over system and would supply the propane at the same price as natural gas, even though propane is more expensive.

9.13 Consumers' was able to identify only 54 customers who might be suitable candidates for conversion to this propane-air option. If all 54 were to be served on a peak day by the propane-air facilities, the peak day demand would be reduced by only 2,300 to 2,700 10^3m^3.

9.14 After deducting the energy costs for the natural gas to serve peak demand, the net operating cost to Consumers' to provide the propane-air, interruptible service to its five largest industrial customers would be $700,000 annually.

9.15 Problems were anticipated by Consumers' in acquiring municipal approvals for the property rezonings that would be required. Objections were also anticipated with respect to the additional traffic with propane cargoes.

9.16 The point-of-use method did not meet the cold weather test set by Consumers', whereby only 2,800 10^3m^3 of curtailment would be required to meet a peak day demand in 1994 in order that an additional 2,800 10^3m^3 would be available for a 41.5 DDC condition.

9.17 On the basis of these analyses, Consumers' concluded that the point-of-use method was not a suitable solution to meet their needs. Its potential as a load management tool was found to be limited.

9.18 The GSDS model also confirmed that this method required more underground storage and more reliance on TCPL to supply additional volumes of gas at a lower load factor. It could not meet the guidelines for curtailment and would be more expensive than the LNG facility.

9.19 Special Counsel submitted that the propane alternative taken alone is not reasonable, relative to the LNG facility, to meet the perceived need because it would satisfy only one-third of the required peaking service. He further argued that the propane alternative could be a suitable demand management technique.

The Tecumseh Alternative

9.20 The Tecumseh underground storage facilities, owned jointly by Consumers' and Imperial Oil Limited, are located 15 km southeast of Sarnia. They are interconnected with the TCPL and Union facilities by two NPS 30 pipelines which run from the reservoirs to Union's Dawn compression station.

9.21 The Tecumseh underground facilities are comprised of five pinnacle reef reservoirs. When the reservoirs are full, the total gas in place is 2,526.9 10^6m^3 at a pressure of 1,100 psi. The working volume of these reservoirs is 1,671 10^6m^3 (59 Bcf) and the remaining space is occupied by cushion gas. Cushion gas is the gas volume needed to maintain a pressure level to deliver gas during a withdrawal period. Below this level, it becomes increasingly difficult to deliver gas.

9.22 Consumers' has a contract to 1996 for Tecumseh's working volume. Tecumseh has contracted to deliver at a peak day rate of 1.71 per cent of its working volume. This rate can be maintained until 72.5 per cent of the working volume has been withdrawn which generally occurs towards the end of February. Tecumseh then provides peak day service on a best efforts basis.

9.23 Consumers' presented three possible options for expanding its underground storage operations. These were identified as Tecumseh A, B and C. Each would involve the transportation of additional volumes on Union's system.

9.24 Consumers' testified that Tecumseh A would involve the addition of four replacement wells to the existing facilities but would provide no additional capacity.

9.25 Tecumseh B includes the facilities proposed for Tecumseh A, as well as increased horsepower at the compressor stations. This would increase peak day deliverability by 20 per cent.

9.26 Tecumseh C would supplement Tecumseh B by adding reservoir capacity of 425,000 10^3m^3 (15 Bcf). Tecumseh C would increase the annual volume available and prolong the period during which the increased peak day capability would be available. Consumers' indicated that the implementation of Tecumseh C required the acquisition of an additional pinnacle reef reservoir, the Dow-Moore Pool. This pool is jointly owned by the Department of Indian Affairs, in trust for the Sarnia Indian Band, and by Dow Chemical Canada Inc.

9.27 The costs of Tecumseh B and C were estimated to be $12 million and $62 million respectively, for storage facilities alone. Union estimated that the transportation of the additional volume of gas through its system would involve a capital cost of $54.2 million.

9.28 Special Counsel submitted that the Tecumseh alternative was not fully explored by Consumers' and that its estimates were conservative and did not necessarily reflect the true potential of each option. The existing peak day to total inventory ratio of Tecumseh has been 1.71 per cent. For Tecumseh C, however, Consumers' assumed a ratio of only 1.33 per cent.

9.29 Special Counsel submitted that a ratio of 1.71 per cent would have provided approximately 86 per cent of the perceived need. He further submitted that a ratio of 2.0 per cent, which is the highest ratio Consumers' considered reasonable, would have provided 100 per cent of Consumers' perceived need.

9.30 During the course of the proceedings, however, Union indicated that it had acquired an option to purchase the Dow-Moore Pool. Since this reservoir was required for Tecumseh C, counsel for Consumers' requested that Tecumseh C receive no further consideration by the Board.

The LNG Facility

9.31 A detailed description of the LNG facility is provided in Chapter 1.

9.32 Consumers' proposed that the optimal solution to its perceived peak day requirements would be the construction of the LNG facility. The company submitted that if the need arose an additional storage tank of equivalent size could be added. However, Consumers' admitted that this alternative was not suitable for meeting seasonal demands.

9.33 The LNG facility would decrease the dependence on pipeline supplies and meet Consumers' guidelines for limiting the use of curtailment for peak day demand. It would also reduce Consumers' reliance on Union's Dawn-Trafalgar system by 7 per cent and would provide a diversity of supply for Consumers' customers.

9.34 Consumers' forecast that while the LNG facility would be fully utilized in 1994, it would be partially utilized as early as the winter of 1988-89.

9.35 The LNG facility would give Consumers' management direct control over the cost of peak shaving. Furthermore, Consumers' could add sufficient vapourizing capability to increase the peak day output by 25 per cent.

9.36 Mr. Mitchell, of Stone and Webster, testified that he agreed with Consumers' analyses of its future seasonal and peak day gas needs and stated that the LNG proposal provided the most economical solution.

9.37 However, Mr. Mitchell agreed with Special Counsel that underground storage would be a better use of provincial resources, all other things being equal. In addition, he testified that Toronto is currently in a relatively secure situation for gas supply sources compared to other Canadian cities.

9.38 In response to questioning by Mrs. Lynda Forbes, Consumers' witnesses explained that the socio-economic and environmental aspects for alternatives, other than the LNG facility, had not been examined. Consumers' did not, for instance, examine these aspects of the Tecumseh or propane alternatives.

Findings and Recommendations

9.39 The Board is of the view that none of the alternatives considered by Consumers', other than the LNG facility, could singularly satisfy the perceived need.

9.40 Given the uncertainty of supply and the prohibitive cost, the Board concludes that the alternative of obtaining additional WPS from TCPL is not feasible. For the same reasons, no other alternative, or combination of alternatives, should rely on TCPL providing WPS in the future.

9.41 Further, the Board finds that the propane alternative is not suitable because it is incapable of meeting the perceived need. However, the Board recognizes that, if required, this alternative could prove to be a valuable demand management technique.

9.42 The Board is of the view that Consumers' evaluation of Tecumseh A, B and C did not necessarily reflect their true potential.

9.43 While the Board recognizes that Tecumseh C might have been a viable alternative, it is not included in the Board's deliberations, at Consumers' request, because of Union's acquisition of an option to purchase the Dow-Moore Pool.

9.44 While the LNG facility is capable of meeting the company's perceived need, in the interest of the public, the Board is of the view that Consumers' actual peak day demand may be best served by other means.

9.45 The Board finds that the criteria used to make the final selection ought to be in agreement with its mandate to "report to the Lieutenant Governor in Council on whether the Project is in the public interest." In this context, the term "public interest" means to the Board:

- to provide the service at the lowest possible cost to the Ontario consumer;
- to ensure that security of supply and system reliability and flexibility are maintained and enhanced; and
- to ensure that safety and environmental concerns are adequately met.

9.46 While the Board respects the judgment of Consumers' experienced management, in this instance, the public interest requires that the Board review other alternatives beyond those strictly within the control of Consumers' and confined in impact to Consumers' customers.

9.47 The Board, therefore, recommends that alternatives which have shorter planning and construction lead times, which allow for additional capacity in smaller increments and can be implemented economically to serve either peak day demand or demand over a broader time period, are preferable in an uncertain environment.

10. A COMPARISON OF THE LNG FACILITY AND THE UNION ALTERNATIVES

Introduction

10.1 The specific definition of the volume available, the cost of each of Union's underground storage alternatives, and the timing of the communication of that information to Consumers' caused considerable dissention during these proceedings.

10.2 As early as 1982, Union was involved in discussions regarding Consumers' peak day concern. In May, 1983, Union was first informed that Consumers' was considering an LNG plant. In March, 1985, it was notified of Consumers' intention to proceed with the LNG alternative. In September, 1985, Union informed Consumers' of its intention to propose storage and transmission-based alternatives to the LNG proposal. After evaluating Union's alternatives, Consumers', however, maintained that the LNG facility remained the most economical method of meeting its requirements.

Union's Alternatives

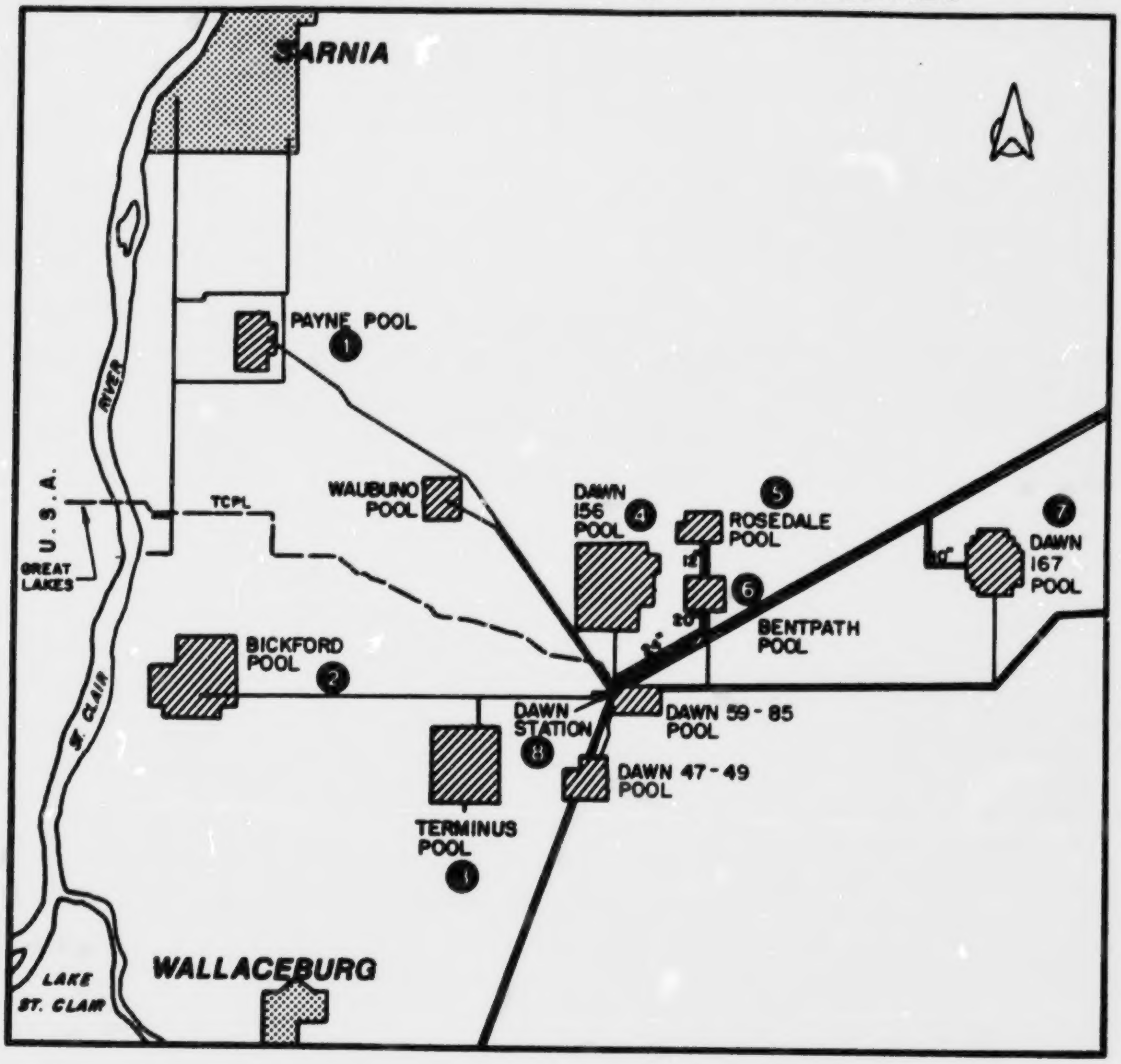
10.3 Union proposed two alternatives, Alternative A and Alternative B, each of which would provide a peak day supply equivalent to the LNG proposal. Union described these alternatives as Storage Peaking Service (SPS). Figures 10A, 10B and 10C illustrate Union's proposed alternatives.

10.4 Alternative A involves a combination of additional storage, transmission, compression and measurement facilities. The storage facilities include: additional wells; new storage lines; field compression; dehydration and compression at the Dawn pool; and an additional 33,000 horsepower of compression at the Dawn Station.

10.5 The transportation component includes two NPS 42 pipeline sections. The first section would be 13.52 km and would provide additional capacity in the Bright to Trafalgar section of Union's main transmission line. The second section would be 18.12 km and would provide additional capacity in the Dawn to Lobo section, providing the necessary suction pressure at the Lobo station. New compression facilities would be added to the Lobo, Bright and Trafalgar

Figure 10A

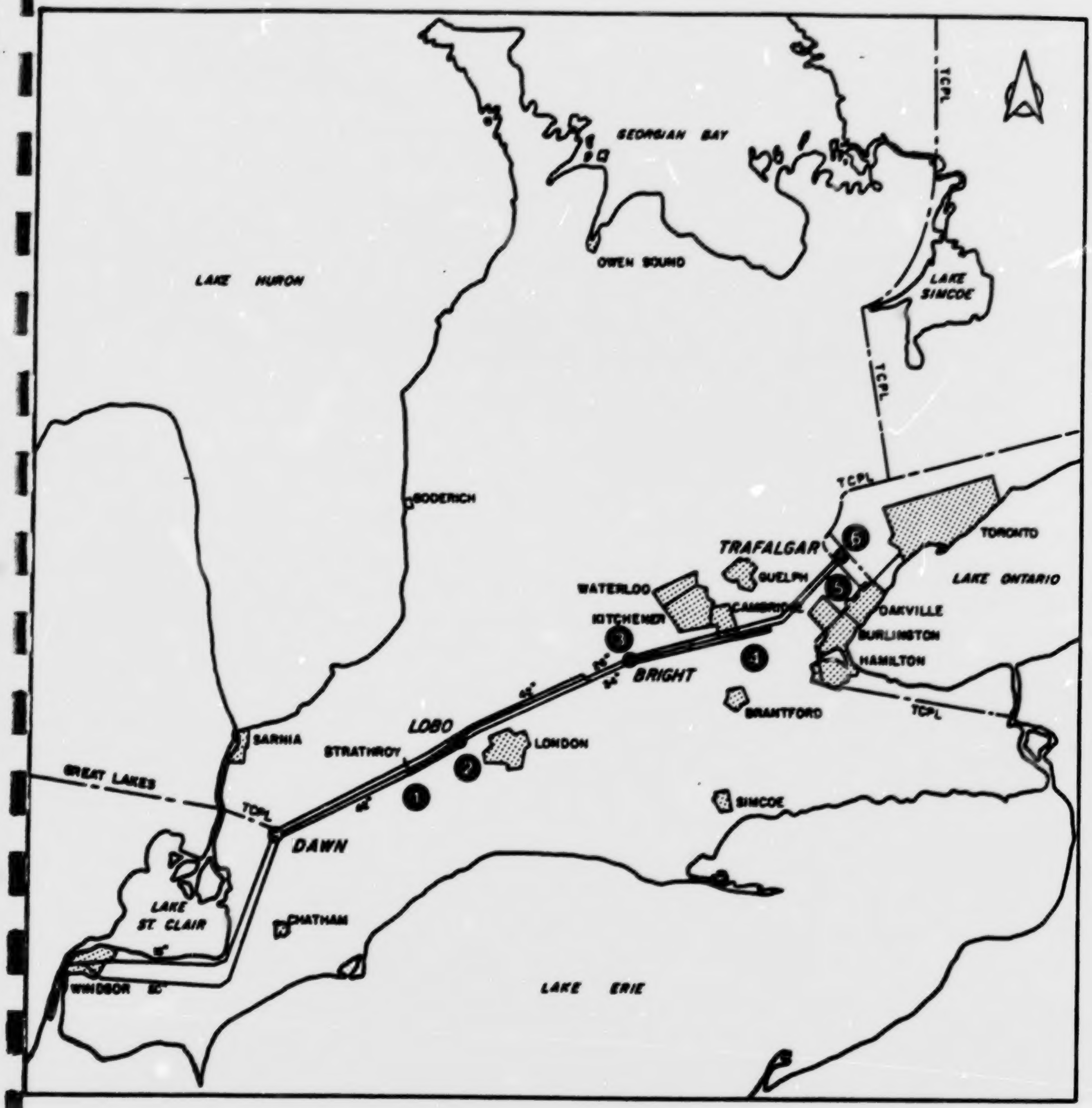
UNION'S ALTERNATIVES A AND B
STORAGE AND STORAGE RELATED FACILITIES


SARNIA
PAYNE POOL
①
ST. CLAIR RIVER
U. S. A.
TCPL
GREAT LAKES
WAUBUNO POOL
DAWN 156 POOL
④
⑤
ROSEDALE POOL
12
⑥
20
BENTPATH POOL
⑦
DAWN 167 POOL
10
BICKFORD POOL
②
DAWN STATION
⑧
DAWN 59 - 85 POOL
DAWN 47 - 49 POOL
TERMINUS POOL
③
WALLACEBURG
LAKE ST. CLAIR

① PAYNE POOL	7 I/W WELLS	⑦ DAWN 167 POOL	10 I/W WELLS
② BICKFORD POOL	3 I/W WELLS		4 OBS WELLS
③ TERMINUS POOL	1 I/W WELL		1500 HP COMPRESSION
④ DAWN 156 POOL	6 I/W WELLS		MEASUREMENT. DEHYDRATION
⑤ ROSEDALE POOL	1 I/W WELL		
	3284m NPS 12		3475m NPS 10
⑥ BENTPATH POOL	3 I/W WELLS	⑧ DAWN STATION	33800 HP COMPRESSION
	1433m NPS 20		
	4554m NPS 24		

Figure 10B

UNION'S ALTERNATIVE A
TRANSMISSION AND TRANSMISSION RELATED FACILITIES


GEORGIAN BAY
OWEN SOUND
LAKE HURON
LAKE SIMCOE
TCPL
GODERICH
TRAFALGAR
GUELPH
TORONTO
LAKE ONTARIO
WATERLOO
KITCHENER
CAMBRIDGE
OAKVILLE
BURLINGTON
HAMILTON
BRIGHT
BRANTFORD
LOBO
STRATHROY
LONDON
SARNIA
GREAT LAKES
DAWN
SIMCOE
LAKE ST. CLAIR
CHATHAM
WINDSOR
LAKE ERIE
1
2
3
4
5
6

① 18.12 KM OF NPS 42

② MODIFY PIPING AND REPLACE AERO ASSEMBLIES

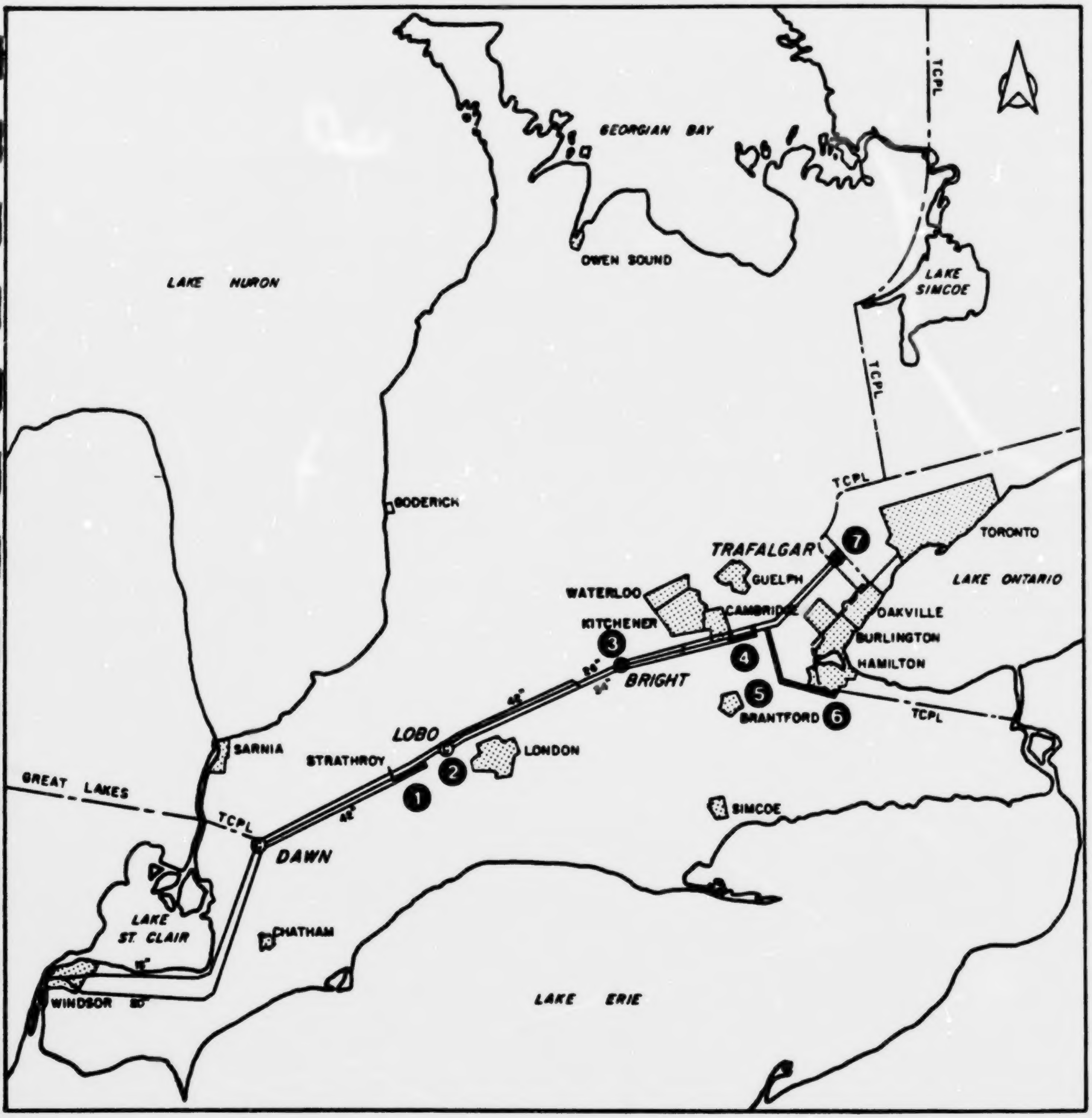
③ ADDITIONAL POWER AND REPLACE AERO ASSEMBLIES

④ 13.53 KM OF NPS 42

⑤ ADDITIONAL COMPRESSOR AT PARKWAY BELT WEST

⑥ ADDITIONAL MEASUREMENT TO TCPL

UNION'S ALTERNATIVE B
TRANSMISSION AND TRANSMISSION RELATED FACILITIES


TCPL
GEORGIAN BAY
OWEN SOUND
LAKE HURON
LAKE SIMCOE
TCPL
TCPL
GODERICH
TRAFALGAR
7
TORONTO
LAKE ONTARIO
GUELPH
WATERLOO
CAMBRIDGE
OAKVILLE
KITCHENER
3
BURLINGTON
4
HAMILTON
BRIGHT
5
BRANTFORD
6
TCPL
LOBO
LONDON
SARNIA
STRATHROY
2
GREAT LAKES
1
SIMCOE
TCPL
42"
DAWN
LAKE ST. CLAIR
CHATHAM
LAKE ERIE
WINDSOR

① 9.06 KM OF NPS 42

② MODIFY PIPING AND REPLACE AERO ASSEMBLIES

③ ADDITIONAL POWER AND REPLACE AERO ASSEMBLIES

④ 8.53 KM OF NPS 42

⑤ 37.8 KM OF NPS 36

⑥ MEASUREMENT TO TCPL

⑦ ADDITIONAL COMPRESSOR AT PARKWAY BELT WEST stations and additional measurement facilities would be installed at the Union-Consumers' exchange point at the Trafalgar Station. These facilities would provide the capacity to deliver Consumers' requirements to TCPL's facility at Lisgar for transmission to Consumers' interconnection at Victoria Square. Additional TCPL measurement facilities might also be required.

10.6 Alternative B involves the identical storage facilities required in Alternative A. The transportation component would, however, include the "Kirkwall Line", an NPS 36 line which would run 37.6 km from a point near Kirkwall and connect the Union system with Hamilton Gate Station #3, near Ancaster. In addition, there would be an NPS 42 loop section extending 8.53 km from the Brantford Take-Off to the Guelph Take-Off to provide added capacity in the Bright to Trafalgar section of the transmission line. There would be another loop section extending 9.06 km easterly from the Strathroy Gate Station to provide additional capacity in the Dawn to Lobo section of the transmission line.

10.7 Modifications and additions would be required to the compression facilities at the Lobo, Bright and Trafalgar stations and additional measurement facilities would be required at Hamilton Gate Station #3.

10.8 Alternative B facilities would also allow a portion of Consumers' peaking volume to be delivered to the TCPL facilities at Ancaster, in exchange for TCPL deliveries to Consumers' at Victoria Square and points easterly on the TCPL system. Union was of the opinion that only increased measurement facilities would need to be installed by TCPL.

10.9 Union submitted that Alternative B was offered for consideration, even though it would be more expensive, because the additional costs would be outweighed by the advantages of the proposal. Specifically, the Kirkwall Line would: reduce the demand on the Trafalgar system to Lisgar; provide a second transfer point to the TCPL Niagara system which would increase the security of supply for TCPL and other eastern Canadian gas distribution utilities; reduce or eliminate the reverse haul on the TCPL Niagara line from Lisgar to Ancaster; provide for additional growth and security of supply for the Union system in the Hamilton Nanticoke areas; provide for daily load balancing; and provide increased export capacity. TCPL indicated, however, that it would intervene in the Union application to construct the Kirkwall Line as TCPL has a similar application before the NEB.

10.10 Union testified that it is prepared to build either Alternative A or Alternative B. In fact, in June, 1986, Union submitted applications to the OEB for approval of the construction of Alternative A or Alternative B. The Board intends to deal with these applications only after being informed as to the Lieutenant Governor in Council's response to this Report.

10.11 The proposed construction schedule would have the facilities in service to meet Consumers' perceived needs for the 1988-89 winter season.

10.12 Union testified that storage and transmission facilities could be added incrementally, over a longer period of time, if the need did not develop as forecast. The construction schedules for Alternatives A and B could be revised as the need developed. Consequently, Union submitted that its alternatives would provide greater flexibility than the LNG alternative.

10.13 Union submitted that its proposal would strengthen the system for customers in eastern Canada. The LNG plant would be capable of only six or seven days of output at the 8,500 10^3m^3 volume, and could not maintain deliveries for an extended period of time. It would take 30 days to replace one day's output. On the other hand, Union submitted, its proposals would offer greater flexibility, including use for seasonal or peaking service depending on market requirements, incremental development and enhanced capability to purchase lower-priced interruptible gas.

Comparison of Union's Alternatives with the LNG Facility

10.14 An examination of Union's and Consumers' projected costs revealed that the methodologies used to evaluate the costs by each company were so diverse that a meaningful comparison was virtually impossible. Basically, Consumers' employed a "cost of service" concept which projected the total cost of the LNG facility to its customers unit cost of gas. Union, on the other hand, calculated the costs of its alternatives to its shareholders.

10.15 In an attempt to rationalize the two methodologies, the Board directed both utilities to provide a more comparable analysis. The analysis was to employ certain principles related to:

- the use of current or "as spent" dollars;
- an assumed date for completion of November 1, 1988, with interest accruing during construction to that date;
- assumed rates of inflation, deflation and discount which were to be clearly identified;

- overhead costs which were to be included and identified, including the method of calculation;
- contingency costs which were to be identified along with supporting rationale;
- costs attributed to base load growth which were to be excluded; and
- all factors used in the economic analysis, such as depreciation rates, rates of return, capital cost allowance and tax rates, which were to be clearly identified.

Capital Costs

10.16 A preliminary cost estimate of $90.8 million for the LNG facility was provided by Consumers' based on the costs of similar facilities. During the hearing, Consumers' submitted a revised estimate of $74.3 million (as spent dollars). The cost reduction was based on lower process facility costs brought about by an efficient bidding process and favourable market conditions in the energy sector.

10.17 Union submitted updated estimates of the total capital costs of Alternatives A and B, including interest during construction (IDC) and excluding general overheads, of $96.6 million and $106.5 million (as spent dollars), respectively.

10.18 Table 10.1 summarizes the final revisions of capital costs for comparison purposes.

Table 10.1

Comparison of Capital Costs
($ millions as spent)

	LNG	Alt. A	Alt. B
Storage	64.8	42.2	42.2
Transmission		49.6	58.0
IDC	9.5	4.8	6.3
TOTAL	74.3	96.6	106.5

Annual Operating Costs

10.19 Annual operating costs for the LNG facility include energy, labour, chemicals, refrigerants, maintenance, local taxes and insurance.

10.20 Annual operating costs of the Union alternatives include incremental costs for compression, transmission, storage wells, field lines and stations, municipal taxes and savings in compressor fuel.

10.21 Union submitted that its operating costs would be lower primarily because its alternatives result in significant compressor fuel savings. While Consumers' questioned the validity of these savings, Special Counsel argued that, in a purely incremental approach, these savings are legitimate.

10.22 Table 10.2 lists the annual operating costs, including the TCPL swap costs, which have to be paid to TCPL for the use of its pipeline to transport gas, on behalf of a utility, from one point in the province to another.

Table 10.2

Comparison of Annual Operating Costs
(first year of operation)
($ 000's)

	LNG	Alt. A	Alt. B
Operating costs	3,033.6	99.4	250.1
TCPL swap costs	190.5	236.6	287.2
TOTAL	3,224.1	336.0	537.3

Overall Cost Comparison

10.23 Following the Board's direction, Consumers' filed an analysis which compared the cost of the LNG project and Union's Alternatives A and B from the point of view of Consumers' customers. This analysis makes extensive use of its cost of service model which details the revenue requirement that Consumers' customers will have to bear over a 20 year period. This stream of annual revenue requirement is subsequently discounted to the present. This results in a Net Present Value (NPV) comparison of the cost of service for each alternative.

10.24 Consumers' model is considered to be an incremental cost approach in that it calculates the cost of adding each alternative to Consumers' or Union's existing gas distribution system. As such, only facilities added to the system to provide the particular service ought to be included in the cost calculations.

10.25 Consumers' submitted two analyses for the LNG facility. One calculation utilizes a Class 2 Capital Cost Allowance (CCA), which allows a 6 per cent annual depreciation rate for tax purposes. The second calculation utilizes a Class 8 CCA, which allows a 20 per cent annual depreciation rate for tax purposes. The latter classification is more advantageous for Consumers' as the Class 8 CCA provides Consumers' with more tax benefits and reduces the NPV of the project by $22.2 million.

10.26 Union's response to the Board's direction compared the costs of the LNG facility and Alternative A from a shareholder's point of view. This analysis is based on computer models which provide both revenue and capital cashflows for each alternative over a twenty-year period. The stream of cashflows is then discounted to the present, providing the present value of each of the alternatives. The discount rate used in Union's calculations is its average after-tax cost of capital. While Alternative B was referred to in the Board's direction, it was later removed from consideration as it became apparent that it would cost considerably more than the other alternatives.

10.27 Union indicated that it would adopt the existing M12 rate methodology to determine the annual charge to Consumers' for the proposed SPS. This is a "rolled in" cost methodology and it differs from a purely incremental cost approach in that it allocates to the Rate M12 customer a portion of all costs, some of which may not relate to the new service. For Alternative A, the annual cost to Consumers' ranges from $19.6 million in the first year to $13.7 million in the twentieth year. This stream of annual payments is then discounted using year-end discounting.

10.28 The NPV calculation of Alternative A was updated by Union to be $138.9 million (1988 dollars). To this another $11.8 million must be added to cover TCPL swap costs and inventory carrying costs for the 56,600 10^3m^3 (2 Bcf) of inventory gas that Union would have to carry in order to provide the peaking service. This, according to Union, would bring the total cost of Alternative A allocated to Consumers' customers to $150.1 million.

Economic Issues of Contention

10.29 There were a number of economic issues that remained outstanding and represented the different views of the two companies. These economic issues were:

- Tax treatment;
- Incremental versus allocated costs;
- Mid-year versus year-end discounting;
- Escalation of gas prices;
- Interest during construction;
- Residual value;
- Commodity charge;
- Peaking service; and
- Treatment of Consumers' sunk costs to date.

Tax Treatment

10.30 Consumers' testified that it intends to claim the LNG facility under a Class 8 CCA. Such action may or may not be challenged by Revenue Canada.

10.31 Union testified that preliminary legal advice it had obtained indicated that the facilities should fall under Class 2 CCA.

Incremental versus Allocated Costs

10.32 Consumers' maintained that only the costs to its customers should form the basis of comparison between the alternatives.

10.33 Consumers' argued that since Rate M12 methodology allocates costs to all M12 customers, the costs allocated to it by Union may not fairly represent the value of the service it is receiving.

10.34 Consumers' also maintained that Rate M12 is subject to regulatory review which could introduce further uncertainty as to the future allocation of costs.

10.35 The present value of the general overheads was originally estimated by Union to be $6.4 million and was later adjusted by Consumers' to $5.7 million. Union disagreed with the downward adjustment and submitted that an upward adjustment to $6.7 million would be more appropriate.

10.36 Consumers' also contended that 113,300 10^3m^3 (4 Bcf) of cushion gas would be required to support the specified deliverability of Alternative A, and would involve an additional $36.2 million (present value) in carrying costs. It submitted, therefore, that this amount should be treated as an incremental cost of the SPS.

10.37 Special Counsel submitted that in a purely incremental cost calculation general overheads and the 4 Bcf of cushion gas carrying costs should not be included.

10.38 In addition, he submitted that the Board should not give significant weight to the cost allocation matter since Union could adjust the allocation to eliminate any advantage that might flow to other Rate M12 customers.

Mid-Year versus Year-End Discounting

10.39 Consumers' uses mid-year discounting and Union uses year-end discounting for present value calculations. Each methodology has been approved by the Board in determining economic feasibility for the respective companies. This difference introduces a discrepancy that may be as high as 5 per cent when a comparison of results of each methodology is conducted.

10.40 Special Counsel submitted that the approach should be consistent. He submitted that Consumers' altered Union's calculations to reflect mid-year discounting and that he considered this change appropriate.

Escalation of Gas Prices

10.41 Union, in its financial analysis, assumed a constant price of gas without escalation for the next twenty years.

10.42 Consumers' assumed a price drop in the short term followed by a price adjustment for inflation for the twenty year period.

10.43 Special Counsel submitted that while forecasting is difficult, Consumers' position is more realistic and should be adopted by the Board.

Interest During Construction

10.44 The Board directed that IDC be calculated to November 1, 1988, for all alternatives. Union indicated that, for its cost updates, IDC was terminated at the time each component of the facilities would be placed in service. Union further estimated that the additional cost of IDC, carried to November 1, 1988, would be $1.4 million.

10.45 Special Counsel and Consumers' submitted that this additional cost should be added to the NPV calculation.

Residual Value

10.46 Residual value is defined as the undepreciated portion of the project cost at the end of the twentieth year. Consumers' submitted that a proper NPV calculation ought to include this residual amount. Union submitted that such treatment would be inappropriate.

Commodity Charge

10.47 The commodity charge involves the present value of the incremental cost of compressor fuel for storage and transmission. Union indicated that this charge would be reduced significantly with its allocation for incremental fuel savings.

10.48 Consumers', however, submitted that no evidence was led that demonstrated that fuel savings would benefit its customers.

Peaking Service

10.49 During the proceedings, it became apparent that the LNG facility might not be in service by the winter of 1988-89. Union submitted that Consumers' would therefore be required to purchase 1 Bcf of peaking service from TCPL at a cost of $1.8 million.

Treatment of Consumers' Sunk Costs to Date

10.50 Sunk costs are all the costs that have been incurred to date by both Consumers' and Union in relation to their respective proposals.

10.51 Consumers' has conducted detailed feasibility and engineering studies relating to the proposed LNG facility and incurred costs of approximately $5 million. It argued that these sunk costs should be considered incremental to the cost of Alternative A because they were properly incurred and ought to be recovered from its customers.

Public Interest Considerations

10.52 In addition to comparing the alternatives on the basis of their cost impact, the Board examined other public interest factors that must be considered in the overall evaluation. These factors are: security of supply; system reliability and flexibility; and operational control.

Security of Supply

10.53 Consumers' submitted that one of the critical points in its supply system is the Lisgar Station where natural gas is transferred from Union's system to Consumers'. It testified that a complete failure at that point on a peak day could result in a shortfall of 8,500 10^3m^3 after all other sources of emergency supplies were exhausted. The company indicated that if the LNG facility was constructed, it would eliminate this concern. However, Consumers' agreed that this concern has been significantly reduced by the Board's recent approval of its Parkway Belt West pipeline which provides a bypass of the Lisgar and Trafalgar stations.

10.54 Nevertheless, Consumers' submitted that there are other critical points on the transmission system where a failure could result in a province-wide emergency which could be alleviated by the LNG facility being located east of Toronto.

10.55 TCPL agreed that both the Consumers' and Union proposals would enhance the security of supply to eastern Canada. However, TCPL expressed the view that the Union alternatives would provide greater security of supply in the event of a major emergency since it could be used to bring in additional gas supplies from the United States.

10.56 Special Counsel submitted that the Board should place only modest weight on security of supply in its evaluation of these alternatives. He pointed out, however, that in the underground storage option, when the design inventory is depleted, there remains in the storage pools a substantial inventory of cushion gas which can be used in an emergency situation. On the other hand, when the design inventory of the LNG option is depleted, there is no further gas available.

10.57 Union submitted that the storage and transmission facilities that would be added to the Dawn-Trafalgar system, under Alternative A, would significantly enhance the security of supply to all system users.

System Reliability and Flexibility

10.58 Union submitted that its proposed SPS would enhance the use of existing storage systems and would assist in future undertakings to increase the storage capacity as needed. It further argued that its alternatives offer more flexibility as it could phase in the facilities incrementally, if the annual and peak day need arose more slowly than forecast by Consumers'. On the other hand, it submitted, the capacity of the LNG facility is fixed. In addition, Union submitted that the LNG plant is designed to function strictly as a peak shaving facility while its alternatives can be used for seasonal and peak shaving services.

10.59 Special Counsel agreed with Consumers' that Union sacrifices some potential for seasonal storage capability to provide the peaking service. He added, however, that this sacrifice could be overcome, if peak day demand grew faster than forecast and seasonal demand did not, by adding either a reservoir or more wells to provide the additional service. On the other hand, he submitted, Consumers' would have to construct an additional tank and liquefaction facility to meet these requirements.

Operational Control

10.60 Consumers' submitted that it is desirable from an operational and a strategic point of view that the utility experiencing the changes in demand for gas also control the resources and facilities required to satisfy that demand.

10.61 Special Counsel agreed that, if all other factors are equal, the utility needing the service should be able to construct, own and operate the requisite facilities.

10.62 Union submitted that the ownership of the facilities is insignificant since the advantages of its additional underground storage will accrue to all Ontario gas users.

Findings and Recommendations

10.63 The Board recognizes that the presence of competing alternatives has resulted in significant reductions in the estimated costs of each proposal, which can only benefit the Ontario gas user. In addition, favourable market conditions in the energy sector have made further cost reductions of the LNG facility possible. The Board finds that Consumers' $74.3 million capital cost estimate for the LNG facility is reasonable.

10.64 The Board finds that the capital costs of Union's Alternatives A and B, including IDC and excluding general overheads, estimated by Union to be $96.6 and $106.5 million, respectively, are also reasonable.

10.65 The Board finds that the average annual operating costs of the LNG facility are significantly higher than the average annual operating costs of either of the Union alternatives, as set out in Table 10.2.

10.66 The Board is of the view that for the purpose of comparing the various alternatives, an incremental cost methodology is appropriate and only costs incurred incrementally by either company in order to provide the peaking service should be included in the capital cost and NPV calculations. This is consistent with the Board's opinion that the public interest requires that all gas users in Ontario should enjoy the benefits, not just Consumers' customers.

10.67 The Board recognizes that under present tax law, the LNG facility falls under Class 2 CCA. The Board, therefore, accepts that Class 2 is currently the appropriate basis upon which to compare the costs of the proposed facility.

10.68 The Board finds that the cost allocation methodology ought not to be a determinant when choosing among the various alternatives that will provide the same peaking service to Ontario gas users. Under its mandate, the Board must ensure that costs are allocated to gas users fairly and equitably. This function must be accomplished within its annual rate-setting hearings for each utility, and not in advance.

10.69 More specifically, the Board finds that general overheads and the 4 Bcf cushion gas carrying cost should be excluded from Consumers' calculation of Alternative A, as neither represent an incremental cost to Union's system.

10.70 The Board further finds that, for cost comparison purposes, the mid-year discounting method is acceptable and that the cost adjustments made by Consumers' are appropriate, with the exception of the overhead adjustment of $6.4

million. This should have been adjusted upward to approximately $6.7 million to reflect mid-year discounting, and not downward to $5.7 million as suggested by Consumers'.

10.71 The Board is of the view that an inflation-adjusted price of gas is a realistic assumption and accepts Consumers' correction for the cost of Alternative A as reasonable and appropriate.

10.72 The Board considers that an adjustment to IDC of $1.4 million should be added to the NPV of Union's calculation of the cost of Alternative A.

10.73 The Board finds that the residual value ought to be included in Consumers' NPV calculation. The Board finds, therefore, that an amount of $6.3 million should be properly added to Union's incremental cost calculation.

10.74 The Board is of the opinion that the Union alternatives will likely result in higher operating efficiency on its transmission system. The fuel cost savings, therefore, constitute a legitimate cost reduction. The Board finds that a net savings of $6.6 million in compressor fuel over a period of twenty years of service for Alternative A, as adjusted by Consumers', is reasonable and acceptable.

10.75 As the LNG facility will not be in service for the winter of 1988-89, Consumers' will incur costs of approximately $1.8 million for 1 Bcf of WPS from TCPL during that period. The Board is, therefore, of the view that this additional expense should be added to the cost of the LNG facility.

10.76 While the Board recognizes that sunk costs may be addressed in subsequent rate hearings, in this instance, it is of the view that the sunk costs of approximately $5 million, incurred by Consumers', should not be treated as incremental to the costs of Union's alternatives.

10.77 The Board is of the opinion that, for cost comparison purposes, the NPV of the LNG facility is $169.8 million and the NPV of Union's Alternative A is $155.2 million. Alternative B is not included in the Board's adjusted cost comparison as it was removed from consideration when it became apparent that the costs of its implementation were excessive.

10.78 Table 10.3 summarizes the adjustments that the Board finds appropriate for cost comparison purposes.

Table 10.3

Adjusted Cost Comparison
(in millions of 1988 dollars)

	LNG	Alt. A	Alt. A
Total NPV at 10% discount(A)	168.0(B)	149.0(C)	198.5(D)
Overhead adjustment		(6.7)	(6.7)
4 Bcf adjustment			(36.2)
TCPL swap costs and 2 Bcf carrying cost		11.8	
Interest during construction		1.4	
Residual		6.3	
Commodity charge		(6.6)	
Peaking service	1.8		
TOTAL	169.8	155.2	155.6

(A) As adjusted by Consumers' for mid-year discounting.

(B) Based on Consumers' update using a Class 2 CCA tax treatment.

(C) Based on Consumers' revision to Union's update of its incremental costs to Ontario.

(D) Based on Consumers' revision to Union's update of its incremental costs to Consumers' customers.

10.79 The Board finds that in terms of security of supply, both Alternative A and the LNG facility will enhance the security of Ontario's natural gas system. However, the Board is of the view that the underground storage alternative provides a substantial quantity of cushion gas which, in an emergency situation, may be used. This is not the case with the LNG facility. Therefore, the Board is of the view that, from a provincial perspective, Union's Alternative A constitutes a more secure and reliable source of supply than the LNG facility.

10.80 The Board is of the opinion that from a provincial perspective, the public interest requires that the Board consider not only ownership and operational control but also which alternative is best for Ontario.

10.81 In addition, the Board finds Union's alternative to be more flexible as it will have shorter planning and construction lead times, will allow for additional capacity in smaller increments and can be implemented economically to serve either peak day demand or demand over a broader time period.

10.82 Therefore, the Board concludes that, from a provincial perspective, Union's Alternative A is preferrable to the LNG Project.

11. DESIGN AND SAFETY OF THE LNG FACILITY

Introduction

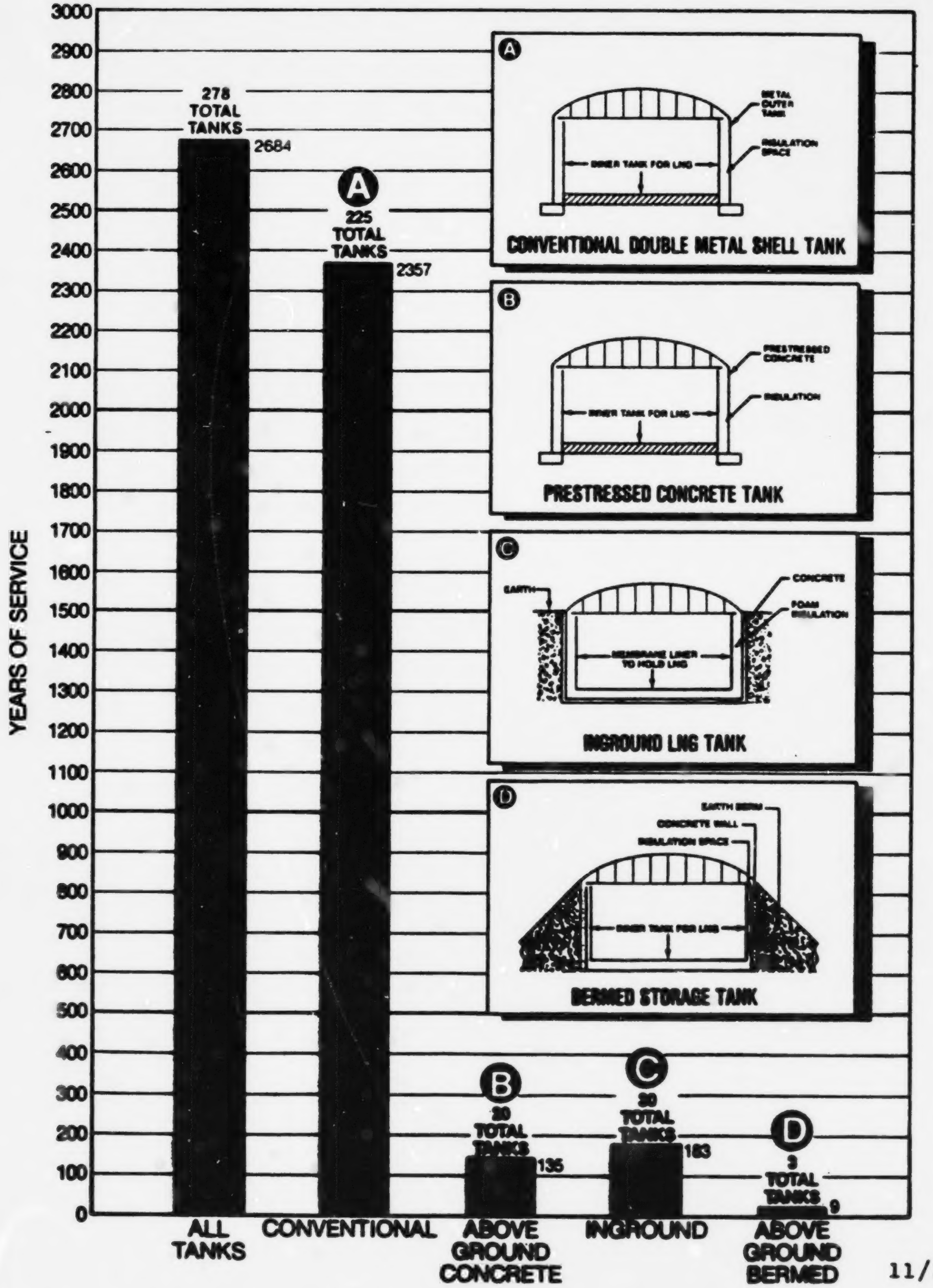
11.1 Progress in LNG technology has been heavily influenced by safety considerations. The CSA Z276 committee is comprised of individuals from government, facility designers, contractors, operators and insurers. This balance ensures that all aspects of LNG plant safety are addressed by the standard. Over 80 per cent of the LNG plants around the world have been constructed to CSA Z276 or its United States equivalent, NFPA 59A. These standards require that LNG facilities be designed to high levels of safety, to control potential releases and to protect the public in the event of an accident. While it is currently used only as a guideline in the industry, CSA Z276 is the subject of a proposed regulation under the Energy Act (R.S.O. 1980, Chapter 139, as amended) and will, therefore, soon have the force of law in Ontario.

Natural gas is a clear, colourless, non-toxic gas. It is flammable within the range of about 5 to 15 per cent natural gas concentration in air. When LNG is heated, the liquid evaporates and returns to the gaseous form. Natural gas is lighter than air at temperatures above -100°C and because of its natural buoyancy and diffusion, it disperses in air when released. Neither natural gas nor LNG are chemically reactive.

The Storage Tank

11.2 Once the natural gas has been converted to a liquid, it flows to the LNG storage tank where it is stored at essentially atmospheric pressure. Consumers' safety expert, Dr. Brown, indicated that the company considered four different types of design for the storage tank. These included: an above-ground, prestressed concrete tank; an in-ground tank; an above-ground, bermed tank; and a conventional above-ground tank. A simplified description of each design can be found in Figure 11A.

11.3 Consumers' has selected the conventional above-ground tank, which is a tank within a tank, because of its proven operating experience and because rigorous design codes and inspection standards apply to its construction. All of the existing conventional tanks, it



LNG STORAGE TANKS AND SERVICE RECORD

indicated, have been built to the NFPA 59A, CSA Z276 or the American Petroleum Institute (API) Standard 620-Chapter Q.

11.4 The conventional tank is significantly less expensive than the alternative types and Dr. Brown indicated that there are numerous contractors in North America who are capable of building and who have built tanks of this design. He testified that there are approximately 225 conventional tanks in service worldwide, representing, in aggregate, 2,357 years of operating experience.

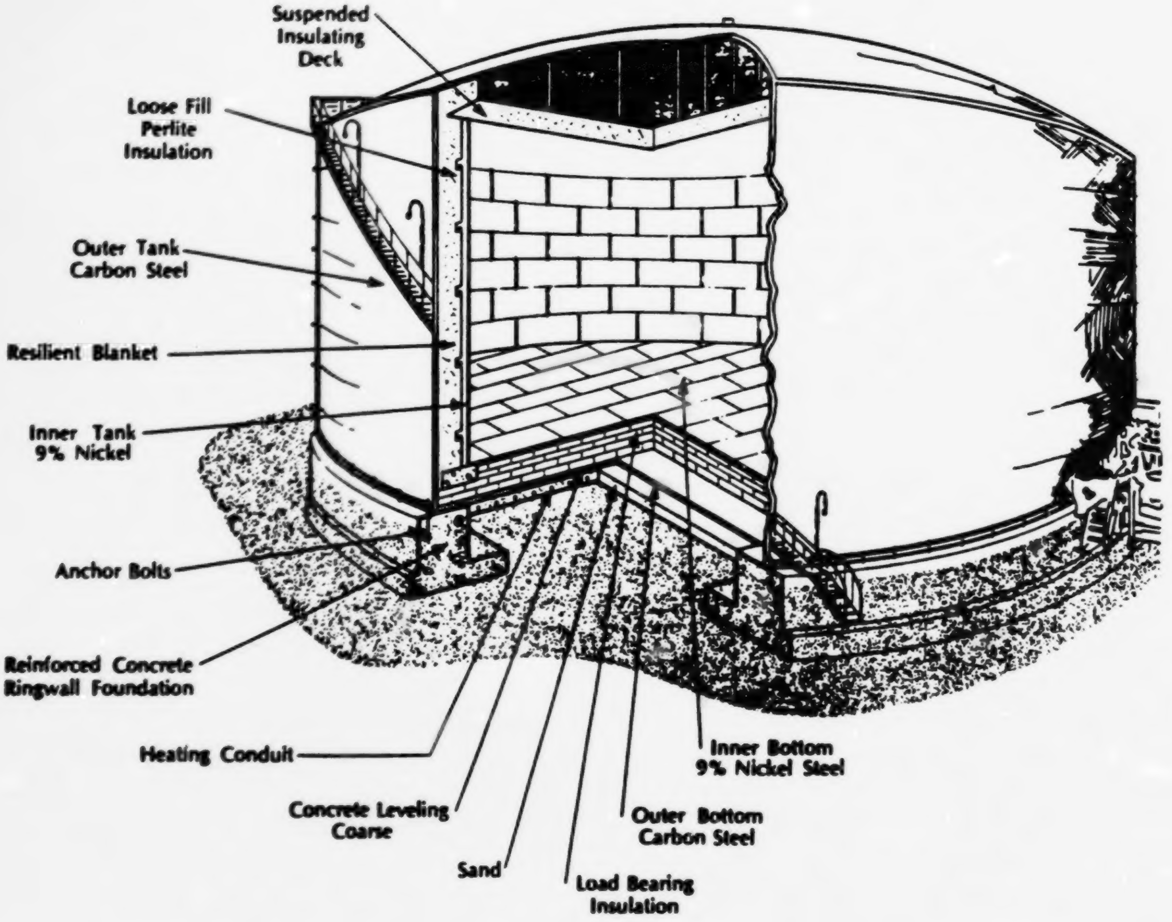
11.5 The conventional above-ground tank consists of an inner tank constructed of 9 per cent nickel steel and an outer tank constructed of ordinary carbon steel. The two tank walls are separated by a space of one metre which is filled with perlite insulation. The top of the tank is insulated with foam-glass wool.

11.6 Mr. Neil Baird, an intervenor, submitted that in the interests of safety Consumers' should be required to construct an in-ground storage tank. However, Dr. Brown testified that in all tank designs some heat enters from the outside environment into the tank which causes the LNG to evaporate, producing boil-off gas. He testified that the boil-off rate with the in-ground tank is too great for the design to be practical for a peak shaving facility but indicated that the design was more useful where availability of space and restrictive land use regulations were a problem, as is the case in Japan.

11.7 Consumers' submitted that, while specifications and standards in respect of the prestressed concrete tank have been in place for two years, no actual tanks of that design have been constructed in that period. Furthermore, there are no specifications or standards in place for the above-ground, bermed type of tank. The specifications for the in-ground tank are the exclusive property of the Tokyo Gas Company Limited and Tokyo Electric Power Company Inc. and are difficult and expensive to obtain.

11.8 Consumers' selected Horton (CBI) Limited as the contractor for the storage tank, and has entered into an agreement whereby, should the LNG facility receive the necessary approvals within a specified period of time, that company would commence construction of the tank. The general layout of the proposed storage tank can be found in Figure 11B. It was pointed out that Horton (CBI) Limited, its parent, subsidiaries or licensees have built approximately 125 tanks of this design since 1957.

Conventional Double-Wall LNG Tank


Suspended Insulating Deck
Loose Fill Perlite Insulation
Outer Tank Carbon Steel
Resilient Blanket
Inner Tank 9% Nickel
Anchor Bolts
Reinforced Concrete Ringwall Foundation
Heating Conduit
Concrete Leveling Coarse
Sand
Load Bearing Insulation
Outer Bottom Carbon Steel
Inner Bottom 9% Nickel Steel

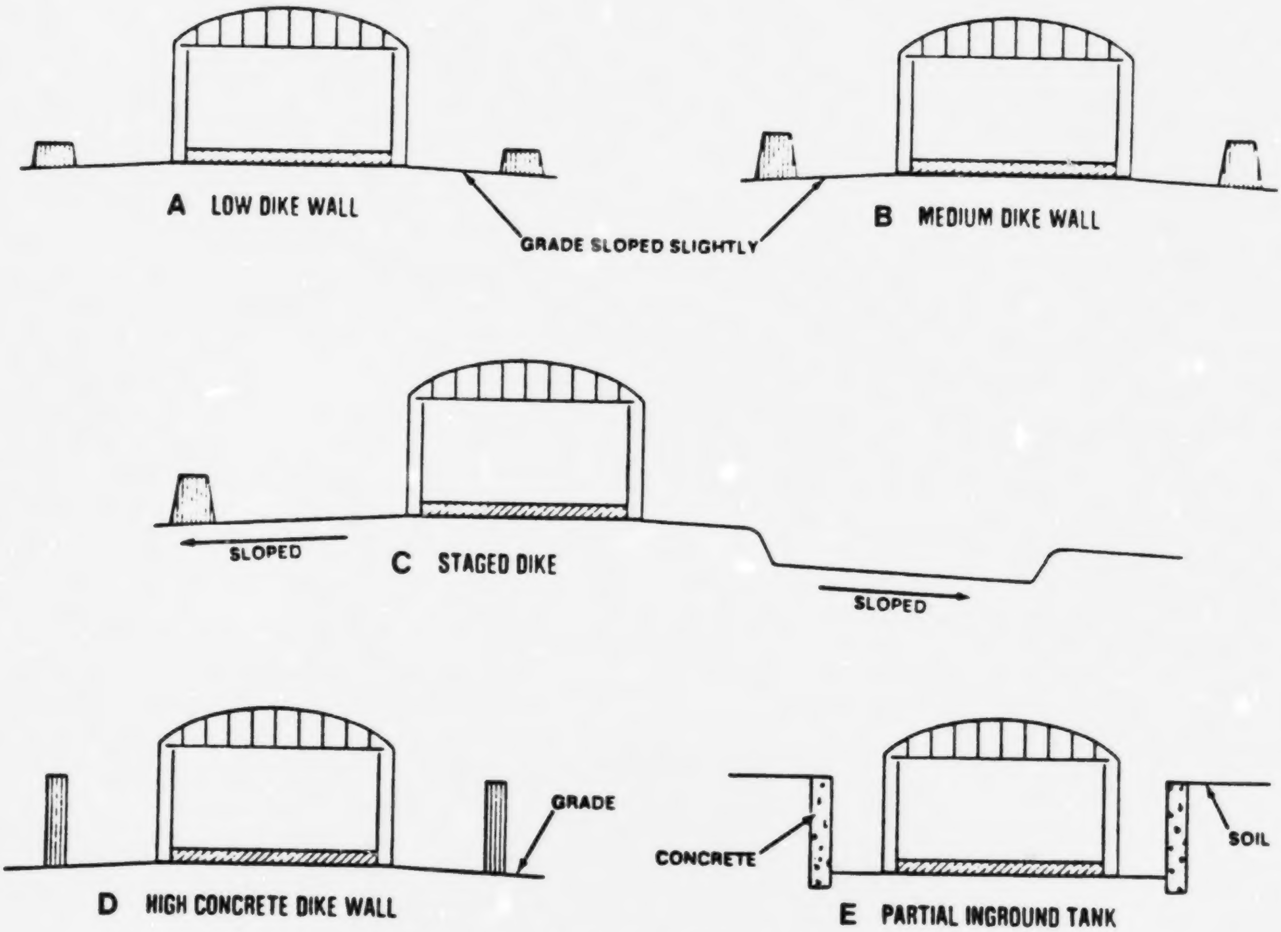
The Diking System

11.9 All LNG facilities are equipped with a release containment structure which acts as a reservoir in the event that LNG escapes.

11.10 Dr. Brown indicated that there are five types of containment or diking designs that are used in conjunction with conventional LNG storage tanks. There are three earthen wall dikes, including a low-profile, a medium profile and a staged design. In addition, there are two concrete wall dikes, one of which is a high dike and the other, a partial in-ground dike design. Figure 11C provides a schematic representation of each design.

11.11 Professor Roberts, an expert in the field of LNG facility design, indicated that the high concrete dike wall design has become more widespread in recent years, particularly where population densities are relatively high and is typical of installations built in Britain since the mid-1970's. Furthermore, he stated that if multiple tanks were planned for the site, the dike wall design would be a critical factor to localize the effect, in the event of a fire, to one tank.

Figure 11C


A LOW DIKE WALL
GRADE SLOPED SLIGHTLY
B MEDIUM DIKE WALL
SLOPED
C STAGED DIKE
SLOPED
GRADE
D HIGH CONCRETE DIKE WALL
CONCRETE
SOIL
E PARTIAL INGROUND TANK

DIKES FOR CONVENTIONAL LNG TANKS

11.12 Consumers' indicated that Haldimand-3 is large enough for two conventional LNG tanks; however, its present intention is to build only one. Furthermore, the company testified that due to the topography of Haldimand-3 a high concrete wall design is not required.

11.13 Consumers' selected the staged earthen dike. It submitted that with this design the tank is readily visible for inspection at all times and that the drainage system reduces the risk of exposure to the storage tank in the event of fire.

11.14 Consumers' indicated that the dike will be designed to contain a volume exceeding the capacity of the tank. In addition, it indicated that the dike floor would be sloped to drain LNG away from the tank. A pump will be provided to remove accumulations of rain water from the dike. It will be equipped with an LNG detector to prevent the pumping of LNG from the dike in the event of a release.

11.15 Consumers' testified that a gravel or concrete ring will extend ten metres immediately around the tank. The area around the LNG process equipment will be sloped and curbed to direct potential liquid releases to an impoundment area. A curbed channel or trench constructed of cryogenic concrete will run along the LNG pipeways and direct any potential releases to a subimpoundment area. Consumers' indicated that confining a release to a small area will enable plant personnel to more effectively control it.

11.16 Special Counsel expressed concern that a trench fire could result after a spill of LNG and migrate back to the tank. Dr. Brown indicated that approximately one minute after the flow of LNG was stopped from the release source, the liquid would have drained through the trench. He further indicated that the flow would be quite rapid as LNG has approximately one-half the viscosity of water. The company, however, acknowledged that the final design of the impoundment and subimpoundment areas had not been resolved at the time of the hearing.

11.17 The CCH expressed concern regarding the dike capacity in the event of large snowfalls at the site. Consumers' indicated that the main impoundment area will be designed to contain the tank contents, as well as one metre of snow.

11.18 Professor Roberts suggested that Consumers' should provide details of the design and composition of the concrete spillways and the process area, the route to the subimpoundment area and further details of the subimpoundment area before obtaining approval to construct the facility. In addition, Dr. Napier, an expert in the field of the safety of LNG facilities, indicated that he was not satisfied that Consumers' had provided sufficient detail of the diking and impoundment systems.

The Process Facilities

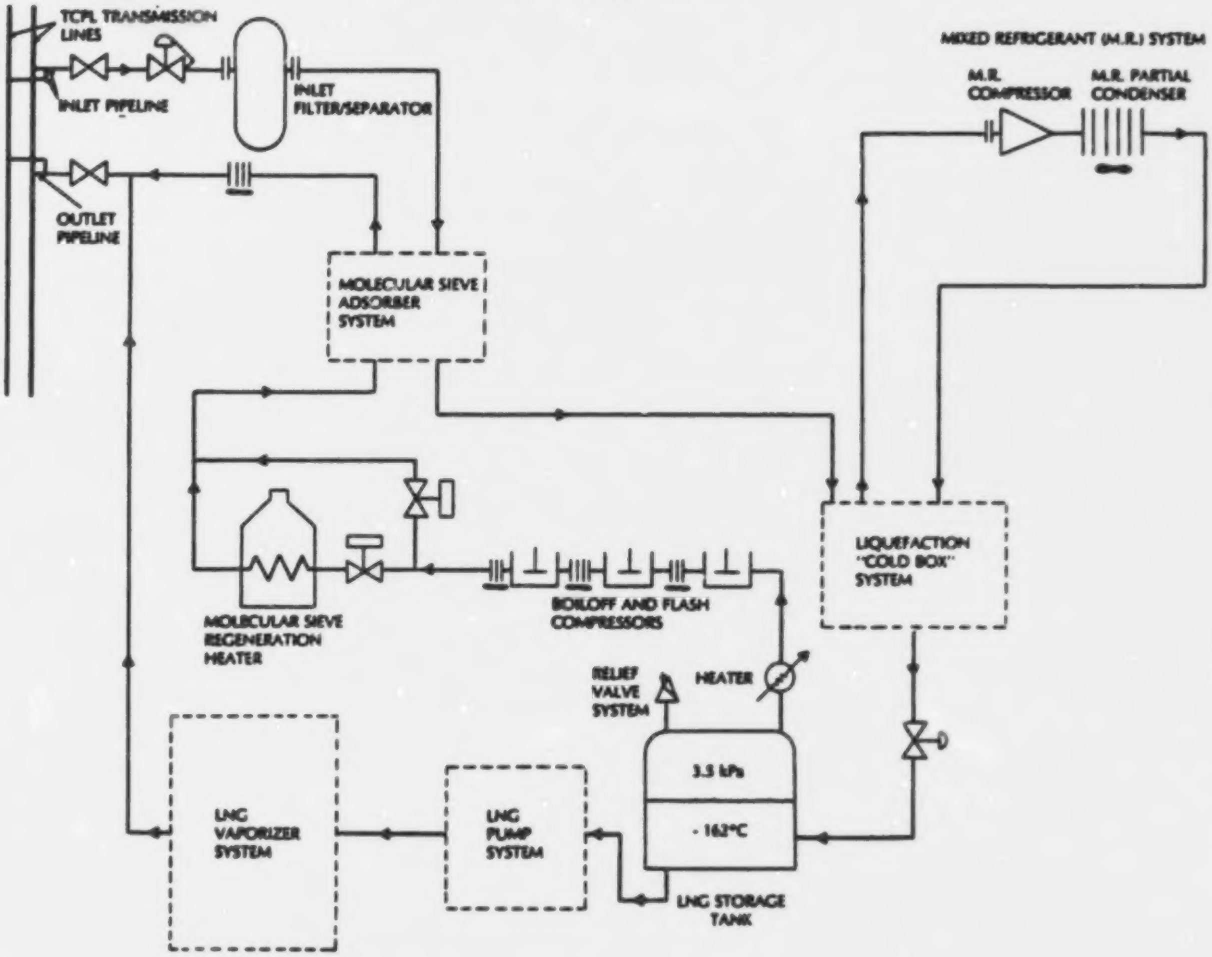
11.19 As noted in Chapter 1, an LNG peak shaving plant includes equipment for removing the carbon dioxide and water from the incoming natural gas, cooling the gas and converting it to a liquid, and facilities for heating the cold liquid to convert it back to a gas. Figure 11D depicts a simplified flow diagram of the proposed LNG facility.

11.20 Although final detailed drawings were not made available to the Board during the course of the hearing, Mr. Reidl indicated, on behalf of Consumers', that while negotiations with respect to the construction of the process facilities were ongoing and that Consumers' had identified Horton (CBI) Limited as the preferred contractor, many details have not been finalized.

11.21 Consumers' submitted that it intends to construct a vent stack to release vented gases from the liquefaction and vapourization systems. Dr. Napier, however, indicated that the company has not provided details as to its location and design and the approximate

Figure 11D

Consumers' Gas
Typical LNG Peakshaving Facility
Simplified Flow Diagram


TCPL TRANSMISSION LINES
INLET PIPELINE
INLET FILTER/SEPARATOR
OUTLET PIPELINE
MIXED REFRIGERANT (M.R.) SYSTEM
M.R. COMPRESSOR
M.R. PARTIAL CONDENSER
MOLECULAR SIEVE ADSORBER SYSTEM
LIQUEFACTION "COLD BOX" SYSTEM
MOLECULAR SIEVE REGENERATION HEATER
BOILOFF AND FLASH COMPRESSORS
RELIEF VALVE SYSTEM
HEATER
3.5 kPa
- 162°C
LNG VAPORIZER SYSTEM
LNG PUMP SYSTEM
LNG STORAGE TANK

composition and volume of the emissions under both routine and emergency situations.

Storage of Refrigerants on the Site

11.22 Consumers' indicated that the refrigerants required for liquefaction including methane, ethane, propane, butane, pentane and nitrogen would be stored on the site.

11.23 Propane, butane and pentane are flammable and, if mishandled, explosions can result. While the company indicated that these gases will be stored in above-ground cylindrical tanks equipped with a leak detector system and pressure relief valves, it acknowledged that explosions could result if the tanks were ruptured. For instance, a boiling liquid expanding vapour explosion (BLEVE) could occur if the tank became over-pressurized or a fire impinged on the tank. In addition, these gases could cause an unconfined vapour cloud explosion (UVCE) if gas escaped from the vessels, mixed appropriately with air and encountered an adequate source of ignition.

11.24 Dr. Brown indicated that while such explosions are very unlikely, all sensitive structures at the proposed facility would be sufficiently remote from the refrigerants to ensure their protection.

11.25 Dr. Napier submitted that the final design must ensure that, should there be a UVCE at the site, the control room would remain intact and workable. In his opinion, the control room at the proposed facility ought to be constructed to withstand at least ten and one-half psi of over-pressure.

11.26 Dr. Napier indicated that Consumers' ought to provide details of the proposed refrigerant storage tanks and filling procedures and the method through which the integrity of the nitrogen supply will be maintained.

Top versus Bottom Connections

11.27 CSA Z276 requires that LNG plants be provided with a public separation zone to protect the public in the event of a high, medium, low, or very low probability accident. Certain accidental releases are referred to by CSA Z276 as "design spills." Two design spills were assessed by Consumers'.

11.28 The first assumed all tank connections pass through the tank roof and the LNG withdrawal pumps are located inside the tank (600 second design spill time) resulting in a release of 96 m^3 of LNG.

11.29 The second assumed the connections pass through the wall or bottom of the tank (1 hour design spill time) resulting in a release of 3,276 m^3 of LNG. This design requires that the tank connection be fitted with an internal shut-off valve.

11.30 Consumers' proposal incorporates a bottom connection from which a stainless steel pipe will lead to an external LNG transfer pump. The company submitted that this connection does not impair the integrity of the tank because the penetration is designed in accordance with CSA Z276.

11.31 Dr. Brown indicated that the bottom connection is more advantageous because it is immediately visible and can be more easily maintained than the top connection. He also testified that all the tanks presently under construction employ the bottom connection and external pump. The fact that the top connection and internal pump system costs approximately $1.5 million more than the bottom arrangement was not considered significant by the company.

11.32 Professor Roberts indicated that connections entering and leaving through the top of the tank are a better engineering solution.

Weather and Seismic Data

11.33 CSA Z276 requires that an LNG plant be designed to withstand a wind speed with the potential for recurrence of once in 100 years or based on plant site data. The closest meteorological station to the candidate sites is at Canadian Forces Base (CFB), Trenton. Over the period 1955 to 1980, the maximum wind gust measured at the station was 154 kilometres/hour (km/h), and the maximum, average, hourly wind speed recorded was 105 km/h. Consumers' indicated that the plant design will exceed the requirements of CSA Z276.

11.34 The earthquake design requirements in CSA Z276 specify that the plant be designed to continue operating after experiencing an earthquake with a recurrence level of once in 475 years. This is called an operating base earthquake (OBE). Key plant elements, including LNG tanks, dikes, emergency shutdown devices and fire protection systems must be designed for a once in 10,000 years recurrence earthquake. This is called a safe shutdown earthquake (SSE).

LNG Vapour Clouds and Pool Fires

11.35 If LNG is released, the primary concerns are an LNG vapour cloud fire and an LNG liquid pool fire.

11.36 LNG will absorb heat from the surroundings and will begin to revert to a gas which is heavier than air at temperatures below approximately -100°C. This gas will form a vapour cloud that initially stays close to the ground. As the vapour cloud is warmed, it becomes buoyant and rises rapidly into the atmosphere.

11.37 As an LNG vapour cloud moves downwind, it spreads laterally. The height of the cloud is lower at the leading edges than at the point nearest to the tank. The concentration of gas in air is greatest near the ground and decreases with height.

11.38 The LNG vapour has a lower flammable limit (LFL) of 5 per cent and is not flammable above 15 per cent. Near the source of the cloud, the gas concentration may be greater than 15 per cent. Consumers' indicated that the diluting effect of the air as the cloud drifts downwind will reduce the gas concentration to below 5 per cent. The distance from the cloud source to the 5 per cent concentration line is dependent on many factors such as the size of the release, the surface types encountered, local topography and wind conditions.

11.39 If the flammable portion of the vapour cloud encounters a source of ignition, a fire will result. This type of fire may cover a relatively wide area, but will not last very long. A vapour cloud fire generally does not damage equipment, but can injure people who come into contact with it.

11.40 The flammable vapour above an accumulation of released LNG can be ignited. The size of this type of fire, called a liquid pool fire, is directly related to the area of the liquid pool. Pool fires usually affect smaller areas than vapour cloud fires, but can last longer.

Calculation of the Public Separation Zones

11.41 Dr. Brown indicated that gas cloud dispersion computations have been made for two sets of atmospheric conditions.

11.42 The first set (Pasquill F) consists of a low wind speed, 2 metres per second (m/s), and a stable atmosphere. A stable atmosphere means the wind is blowing straight with no gusts. These conditions are, in most cases, the worst for mixing LNG vapour with the surrounding air and dispersing the LNG vapour. At CFB, Trenton, these atmospheric conditions occur less than 11 per cent of the time.

11.43 The second set (Pasquill D) consists of a wind speed of 5 m/s and a less stable atmosphere. At CFB, Trenton, these conditions occur 56 per cent of the time. Under Pasquill D conditions, there is some gusting which improves the mixing of the air and LNG vapour.

11.44 While Consumers' anticipated that atmospheric conditions at the candidate sites will be similar to those at CFB, Trenton, CSA Z276 specifies that where actual weather data are not available for a specific location, calculations should be made under a "worst case scenario", assuming a stable atmosphere and low wind conditions (Pasquill F).

11.45 Consumers' submitted that vapour cloud travel distances were calculated assuming one-half the LFL of the gas (2.5 per cent in air) to be certain that the calculation of the hazard zones would be conservative.

11.46 Dr. Brown indicated that Consumers' could have selected a public separation zone of 383 m and satisfied the requirements of CSA Z276. The company determined instead that, at any site it selected, it would exceed CSA Z276 and design a public separation zone of 465 m from the centre of the tank. Adequate land is available at all candidate sites to accommodate a public separation zone of this size.

Consequences of a Total Collapse of the Tank

11.47 Consumers' submitted that the LNG storage tank will be designed to safely shutdown based on the earthquake recurrence intervals specified in CSA Z276.

11.48 Dr. Brown noted, however, that the probability that a vapour cloud would fail to ignite in the event of a collapse of the tank is not even addressed in CSA Z276 because, in his opinion, it is not conceivable.

11.49 Nonetheless, Consumers' provided calculations for a sudden collapse of a storage tank which determined that an unignited vapour cloud could travel a maximum of 990 m downwind from the centre of the tank impounding area under stable atmospheric conditions and a 2 m/s wind speed. The calculations were for grass ground cover.

11.50 As these calculations were made prior to the preferred site selection, Consumers' was requested by Special Counsel to recalculate the effects of this scenario taking into account the terrain of Haldimand-3 and its proximity to Highway 401. Dr. Brown submitted that land contours at the Haldimand-3 site would not influence the vapour cloud travel. He testified that if the tank collapsed and the vapour travelled south with the low-lying topography, the potential vapour cloud could travel approximately 1200 m from the impoundment dike centre. The distance to Highway 401, he submitted, is greater than 1200 m and, therefore, a flammable vapour cloud would not reach the highway even if the tank collapsed. Dr. Brown noted that these calculations assumed the worst case scenario. He also stated that a drumlin located in the northwest corner of Haldimand-3 would protect areas northwest of the plant because LNG, being heavier than air, cannot travel uphill.

11.51 Mrs. Forbes requested that Consumers' assess the probability of the storage tank being damaged by a tornado. The company submitted that, based on data regarding the occurrence of tornadoes in Northumberland County, the probability of the tank being damaged is less than one in 3,000,000 per year.

11.52 The company added that the LNG storage tank would be designed to withstand wind speeds in the order of 103 m/s (230 miles per hour) without suffering significant structural damage. Mrs. Forbes, however, maintained that the data indicate that wind speeds associated with tornadoes often exceed 250 miles per hour. Furthermore, she argued, the company's data do not address the effect of a tree or other large object being uprooted by the wind and hurled at the tank at such a high velocity.

11.53 Consumers' replied that the tank could withstand the impact of a small aircraft crashing into the outer shell. The CCH, however, submitted that there are many larger aircraft flying in the vicinity of the site, which were not considered by the company.

11.54 Consumers' replied that while the probability of a tornado or a plane crash was remote, if they did occur the resulting vapour cloud would ignite and burn within the public separation zone.

The Gas Dispersion Model

11.55 Consumers' employed the HEGADAS II model to predict the dispersion of an LNG vapour cloud. Dr. Brown submitted that this model was chosen because it has been extensively evaluated and approved by a number of worldwide experts.

11.56 Dr. Misra, of the Ministry of the Environment (the MOE), submitted that the HEGADAS II model was designed for a flat surface and the results are not valid for the uneven terrain of Haldimand-3. He stated that the Pasquill F condition did not present the worst case scenario in respect of the travel distance of a vapour cloud and that the use of the factor of one-half the LFL of LNG was an arbitrary decision which does not ensure conservative results. In addition, he stated that the HEGADAS II model does not address changes in concentration gradients.

11.57 He also submitted that the assumption that the atmospheric conditions at Haldimand-3 will be similar to those at the meteorological station at CFB, Trenton was misleading. He submitted that for the purposes of low level dispersion calculations, site specific data collected over a five to six year period would be more appropriate. Moreover, he testified that the proximity of Lake Ontario was not considered in the model and could affect the dispersion of gas.

11.58 He indicated that Consumers' also failed to consider the possibility of pockets of LNG vapour travelling beyond 2 km. While Dr. Brown conceded that the pockets of vapour may extend as far as Highway 401, he maintained that the possibility remained extremely remote.

11.59 Dr. Misra testified that while there also exist numerical gas dispersion models, such as SIGMET-N, ZEPHYR, MARIAH II and FEM 3, they are generally too time consuming and expensive. Instead, he suggested that a physical model, based on a wind-tunnel method, ought to be employed.

11.60 Dr. Brown submitted that physical modelling is only in the preliminary stage of its development. Professor Roberts and Dr. Napier both supported this position.

Safety Features of the Proposal

Detection Devices

11.61 Gas detectors will be installed in enclosed spaces and buildings, air intakes to positively ventilated rooms, and several points in the process area.

11.62 Detectors which sense the presence of LNG by its low temperature will be located in sensitive areas of the plant.

11.63 Optical fire detectors will be installed in all enclosures where flammable gases or liquids are processed. All plant maintenance and office buildings will be provided with smoke detectors to detect ordinary flammable material fires in their early stages.

11.64 In addition, all sensitive areas will be monitored using closed-circuit television.

Fire Control

11.65 Consumers' submitted that water is the primary agent for vapour control and fire protection in an LNG plant. It is not sprayed directly on LNG, but can be sprayed into the air to help disperse vapour clouds more quickly or to reduce the radiant heat from a fire.

11.66 A self-contained water system with a capacity of approximately 61,000 m^3 will be provided at the plant. In addition, dry chemicals will be used to extinguish fires. Moreover, inert gas systems, such as Halon 1301, will be used for extinguishing fires in buildings or other enclosed spaces.

Emergency Shutdown Devices

11.67 The LNG plant will incorporate an emergency shutdown system (ESDS) that can quickly stop pumps and compressors and close a series of valves to effectively stop the flow of natural gas, LNG and refrigerants within the plant.

11.68 All valves that are part of the ESDS will be of the "fail-safe" type. This means that each valve will go to its emergency position if the plant loses its electric power or if the valve control system fails. Each valve can also be closed manually if the entire control system fails.

Personnel Training

11.69 Consumers' indicated that all project personnel will receive intensive training in emergency procedures prior to assuming their duties. Training will include realistic simulations of emergency situations. Written manuals which outline approved procedures to be followed in various emergency situations will be prepared and issued to all plant personnel. Refresher courses and safety meetings will be held at regular intervals.

Emergency Procedure Plan

11.70 While it acknowledged that emergency planning procedures are a critical requirement of CSA Z276, Consumers' submitted that it had simply not reached the stage in plant design where it could provide specific solutions to possible hazards raised by Special Counsel.

11.71 A number of intervenors living in the vicinity of Haldimand-3 expressed concern regarding the company's inability to provide detailed information on the procedure it would adopt in the event that an evacuation of the area was required. The CCH submitted that Consumers' was not fully aware of the conditions of the local roads, particularly in winter, or the availability of ambulances and firefighters in the area. Mrs. Forbes explained that in the 15 years in which she has lived in her home, located approximately 750 m from the proposed site, there have been times in winter when the adjacent roads have been impassable for an entire week. Mr. Tom Loughlin, who lives on a farm approximately 2 km from the proposed site, added that because of the open fields in the area, snowdrifts often prevent vehicles from travelling safely in winter.

11.72 Consumers' submitted that it would provide its own firefighting resources and not rely on outside assistance. Furthermore, it has a Development Agreement with the Township of Haldimand which provides that, if all necessary regulatory approvals are obtained and the LNG facility proceeds, the company will make a cash payment of $250,000 to the Township to upgrade Chalet Road, which runs along the perimeter of the selected site. In addition, the Agreement requires Consumers' to provide supplemental snow-ploughing of the roads adjacent to the site throughout the period of operations of the facility.

11.73 The Citizens for Progress and Development in Haldimand submitted that the economic benefits obtained by the Township from the project and the Development Agreement would outweigh the possible dangers posed by the facility. Mr. Peter Greydanus, who owns and works farmland within 1 km of the proposed site, viewed the project as a benefit to the community.

11.74 Mr. Frank Balint submitted that the LNG facility could become an attractive target for terrorist activity due to its location near Highway 401 and two railway lines. He argued that an explosion at the plant could endanger the lives of a large number of innocent people. Mr. Balint maintained that this risk could be completely avoided if the site was located farther from these transportation corridors.

11.75 Consumers' replied that it intends to provide surveillance equipment and fencing around the plant.

Quality Assurance and Quality Control

11.76 For codes and standards to be effective, a rigorous quality control program must be implemented. Consumers' indicated that comprenensive quality assurance and control programs are commonplace in the LNG industry today. A project quality assurance supervisor will be given full authority to implement the procedures.

11.77 As part of the quality assurance program for this project, all welds on field-erected piping, process vessels and the tank, including the fillet welds on the bottom plates, will be inspected and tested in accordance with the American National Standards Institute (ANSI) Standard B31.3, Chemical Plant and Petroleum Refinery Piping. Under ANSI B31.3, 20 per cent of welds on field erected piping must be radiographed. For this project, however, Consumers' submitted that 100 per cent of welds in cryogenic piping will be radiographed. Equipment components will not be placed in service until they have passed all quality assurance tests.

11.78 Consumers' filed both its own Quality Control Manual and that of Horton (CBI) Limited, the contractor it had selected to construct the storage tank. Upon reviewing these manuals, Professor Roberts was of the opinion that, while the subject of quality control was responsibly and thoroughly addressed, adherence to these standards would be best ensured if quality control was kept as remote from the operational management of the facility as is reasonably practical.

Regulation and Monitoring of LNG Facilities

11.79 Professor Roberts testified that in the United Kingdom, applications to construct LNG facilities are reviewed in stages. In the preliminary stage, approval in principle is sought regarding the general parameters of the project, such as location, dimensions and capacity. Subsequently, detailed planning permission is sought for the actual engineering data involved in constructing the project as outlined in the preliminary stage, and the environmental impact is assessed. In the third and final stage, the entire project is reviewed by the Major Hazards Assessment Group particularly with respect to the health and safety guidelines relating to emergency planning, evacuation and firefighting procedures and ongoing monitoring of the plant.

11.80 Special Counsel indicated that a similar process is followed in the United States and that the same general approach should apply in this instance.

11.81 With respect to the existing regulation and monitoring of LNG facilities in Ontario, Mr. Wright of the Ministry of Consumer and Commercial Relations (the MCCR) indicated that the design of all pressurized vessels at the facility operating at a pressure beyond 15 psi would be subject to the requirements of the Boilers and Pressure Vessels Act (R.S.O. 1980, Chapter 46, as amended) and Ontario Regulation 84/80, as amended. Mr. Wright stated that the design of all pressure vessels in the province must also comply with Canadian Standards Association-B51 (CSA B51).

11.82 While this enables the Pressure Vessels Safety Branch to oversee the construction and the design of the liquefaction and pipeline facilities of the plant, as they operate beyond 15 psi, it is not clear that the design and construction of the storage tank, which operates between 0.3 and 1.45 psi, is captured by the legislation. While the design and construction of the tank would be subject to the requirements of CSA Z276, Mr. Grzesik of the Fuels Safety Branch of the MCCP noted that because it has not yet been enacted as a regulation, it acts only as a guideline and does not carry the force of law at this time.

11.83 Mr. Grzesik stated that the company must, prior to construction, file with the Fuels Safety Branch detailed design drawings which conform completely with CSA Z276.

11.84 In addition, all quality assurance manuals and emergency planning procedures must be submitted to the MCCP for review and approval. The MCCP would then submit the emergency plan to the township in which the plant was proposed to be built for comments.

11.85 During the construction of the facilities, inspectors from the Fuels Safety Branch will be in attendance at the site to oversee installation procedures. In addition, all welders employed in the construction phase must first have obtained the requisite certification from the MCCP. Once the construction is completed, the facility owner must obtain a certificate of installation from the Fuels Safety Branch.

11.86 Mr. Wright testified that the codes are minimum standards and that if the Board were to impose more stringent conditions, the MCCP could ensure that they would be followed.

11.87 It became apparent that the MCCP is not at present staffed with individuals who have extensive knowledge and experience in the LNG industry. However, it could retain experienced consultants if special circumstances require.

11.88 LNG facilities in Ontario are also affected by certain provisions of the Operating Engineers Act (R.S.O. 1980, Chapter 363, as amended) in that the chief operator must be licensed by the MCCP to oversee the operations of the plant.

11.89 Special Counsel submitted that once CSA Z276 is passed as a regulation under the Energy Act, a comprehensive framework will exist requiring government review and approval of every phase of the design, construction and monitoring of LNG facilities in Ontario.

Findings and Recommendations

11.90 The Board is of the view that Consumers' has demonstrated that the technology exists to permit the construction and operation of the proposed LNG facility within an acceptable level of safety. The plant, however, must incorporate proper safety features and meticulous attention must be given to quality control to prevent the creation of undue risk to the public.

11.91 The Board is satisfied that the design of the storage tank selected by Consumers' is acceptable as it meets or exceeds the requirements of the codes and standards involved. The evidence indicates that the use of 9 per cent nickel steel for the construction of the inner tank is appropriate as its properties are well understood in the industry and it is able to withstand the cryogenic temperature of LNG.

11.92 Although the bottom connection and external pump arrangement is commonly used, the Board is of the view that the top connection and in-tank pump should be incorporated into the design of the LNG storage facility.

11.93 The Board is also of the view that the staged dike design proposed by Consumers' is acceptable, but that the final detailed design ought to be further assessed by independent experts before final approval is obtained.

11.94 The Board is of the opinion that Consumers' has not supplied sufficient evidence in respect of the final detailed design of the entire facility. The Board recommends that this information should be made available prior to any final certification. This applies particularly with respect to the design of the process facilities and control room, the location of the refrigerants on the site, and most importantly, in respect of the emergency planning procedures to be followed in the event of a major incident.

11.95 The Board is of the view that quality assurance and quality control at the proposed facility have been responsibly and thoroughly addressed. However, it recommends that all quality assurance and quality control files relating to the operation of any LNG facility should be open to scrutiny by an independent, private sector or government inspector rather than by an internal, high-ranking company official.

11.96 The Board is in agreement with the evidence of Dr. Brown and Dr. Napier in respect of the modelling used to calculate the vapour cloud dispersion and separation zones. While it is apparent that there is a difference of scientific opinion, the Board is of the view that, for the purposes of this hearing, the HEGADAS II model used by Consumers' is acceptable for predicting the dispersion of LNG vapour clouds.

11.97 The Board recommends that in the future a staged approval process similar to that which exists in the United Kingdom and some jurisdictions in the United States should be adopted in Ontario with respect to future applications to construct LNG facilities.

11.98 The Board recommends that in the future a public hearing should take place to address the need for the facility, the alternatives to meet that need, the site selection process, the environmental impact assessment, and the general design of the facilities. If satisfied that these concerns have been effectively addressed, approval in principle should follow.

11.99 Subsequently, the detailed design drawings and specifications of the facility should be submitted to the MCCR for review and comment. If satisfied, a permit to construct the facilities should be issued in accordance with CSA Z276 and CSA B51. In the final stage, the construction, inspection, certification and intermittent monitoring of the facilities should become the responsibility of the Fuels Safety Branch of the MCCR.

11.100 The Board strongly recommends that CSA Z276 be enacted as a regulation under the Energy Act as proposed to ensure that the powers of the Fuels Safety Branch are legally enforceable with respect to the design, construction and operation of an LNG storage tank and process facilities. In addition, once passed, the regulation should be regularly amended to reflect the advances and improvements in the design and construction of LNG facilities.

11.101 Furthermore, in the Board's view, it is imperative that experts with knowledge of LNG technology and hands-on experience with LNG plants be retained by the Fuels Safety Branch to evaluate proposals for LNG facilities and to monitor their operation.

11.102 The Board is of the opinion that this review and approval process will adequately ensure that a plant and its related facilities are designed and constructed in a manner that reflects certified safety features and adheres to a high standard of quality control in all phases of the project.

12. THE SITE SELECTION PROCESS

Introduction

12.1 In March, 1984, Consumers' engaged Kilborn Engineering Limited to conduct a feasibility study, including an examination of the availability of land, for an LNG facility.

12.2 It was not until September, 1984, however, that the GSDS team recommended to Consumers' senior management that the LNG alternative appeared to be the clear choice for meeting their peak shaving needs. At that time, proposals were requested from consultants to undertake site selection and environmental assessment studies for the facility.

12.3 The consultant was required to review existing reports and to liaise with the engineering and safety consultants. While information on land availability was provided by Consumers' real estate division, the consultant was required to discuss alternative sites with the company.

12.4 Once a preferred site was selected, the consultants were to prepare a detailed environmental assessment of that site and make recommendations regarding mitigation measures they would deem appropriate for the construction and operation of the facility. In addition, the consultant was required to coordinate a public participation program to inform area residents of the proposal and its potential impacts.

12.5 In November, 1984, Consumers' management approved the LNG proposal and a team of consultants, under the direction of SENES Consultants Limited (SENES), were selected to conduct the site selection study and environmental assessment.

12.6 SENES, in addition to providing overall direction for the study, also reported on meteorology, air quality, noise and surface water issues. Giffels Associates Limited provided advice with regard to demography, land use, heritage, aesthetics, economic effects, vegetation and wildlife and conducted the public participation program. Golder Associates studied the physiography, geology and groundwater. Smith, Hoffman Associates Limited conducted the soil capability and agricultural assessments.

12.7 Dr. Gorber testified regarding the site selection studies and environmental assessment. These were divided into three phases. Phase I was devoted to the identification of a study area, the selection of potential sites and the setting of constraints which would be used to evaluate the selected sites. During the Phase I study, twenty-four potential sites were evaluated and eighteen were eliminated. The Phase II study was devoted to the evaluation of the remaining six candidate sites and the selection of two preferred sites. Phase III comprised the environmental assessment of the preferred site, Haldimand-3, which was chosen by Consumers' over Cramahe-1, the other preferred site identified in the Phase II study.

Phase I - Initial Site Screening

12.8 SENES began the site selection process by defining a study corridor. Port Hope was selected as the western terminus because it concluded that land farther east would be less densely populated, less expensive and more available. The eastern terminus of the corridor was set at Kingston since it is within Consumers' market area and the seismic zone designation increases from Zone 1 to Zone 2 east of Kingston. The consultants also found that the topography of the lands east of Kingston was such that an LNG facility would be highly visible and, therefore, there would be little flexibility in plant siting.

12.9 Initially, the northern and southern boundaries of the study area were determined by a 10 km maximum distance from the TCPL pipeline. Later in the study, this constraint was reduced to 7 km. Figure 12A shows the study area.

12.10 Once the study corridor had been established, SENES, in conjunction with the safety consultant, determined that the property would have to be at least 160 ha, in order to accommodate safety requirements and provide flexibility in siting of the facility on the property.

12.11 The next step undertaken by the consultants was to develop a set of mapping constraints to identify potential sites within the study area.

12.12 The mapping constraints were designed to exclude:

- areas located within 2 km of a community or 1 km from a road where there are more than ten residents per km;

Figure 12A

Study Area

- productive agricultural areas where there is a predominance of Class 1 and Class 2 soils and special or public lands;
- sites crossed by 230 kV or 500 kV transmission lines, rail lines or public roads;
- sites within 0.5 km of Highway 401 because of safety and visibility concerns; and
- locations within 0.5 km of either side of airport runways and 2 km from the ends of such runways.

12.13 In addition, the mapping constraints were designed to identify sites that were:

- within 2 km of an existing 115 kV electrical transmission line; and
- within 7 km of the TCPL pipeline, in order to reduce costs and potential environmental damage associated with the construction of the pipelines connecting the plant with the TCPL pipeline.

12.14 The 115 kV constraint was based on an Order of the MOE, issued in 1976, granting Ontario Hydro an exemption from the provisions of the Environmental Assessment Act for 115 kV transmission lines of less than 2 km in length.

Subsequently, the company determined that a 44 kV line was sufficient service for the LNG project, but it did not attempt to re-evaluate the site selection process even though it had already eliminated potential sites based on the 115 kV constraint.

12.15 With respect to the need for the site to be within 7 km of the TCPL pipeline, Consumers' submitted that a greater distance might require a larger pipeline to compensate for the pressure drop to the plant. It stated that the distance constraint had nothing to do with possible compression costs since it relies only on the pressure from the TCPL pipeline. The company indicated that studies had not been conducted to ascertain what the increased costs might be if a site was farther from the pipeline.

12.16 Dr. Gorber testified that there had been no attempt to rank or weight the constraints as to their relative importance. While Consumers' submitted that any single constraint could eliminate a site from further consideration, the evidence indicated that a site was rejected if two constraints were identified. Dr. Gorber explained that Consumers' was trying to find a good site for its facility, but not necessarily the best site.

12.17 Dr. Gorber testified that the constraints developed by the consultants were influenced by government ministries and agencies only insofar as Consumers' obtained concurrence from the ministries for particular constraints. For example, the Ministry of Transportation and Communications (the MTC) agreed with the 0.5 km set back from Highway 401 and the Ministry of Agriculture and Food (the MAF) agreed with the elimination of sites with a predominance of Class 1 and Class 2 soils.

12.18 He added that while the public had an opportunity to comment on the results of the Phase I process, it was not consulted with respect to the development of the constraints used in the process.

12.19 Dr. Gorber testified that Consumers' had not specifically sought out potential sites in industrial areas. In his opinion, while companies locate in industrial areas in order to have access to sewer services and a labour force, neither are required for the LNG facility. SENES investigated one industrial site at Ernestown, near Kingston, but eliminated it from further consideration because of its proximity to Millhaven penitentiary and the difficulties that would result if an evacuation of the area was required. Futhermore, the Ernestown site was considered to be too far from the TCPL pipeline and new development was anticipated to the east of the industrial park.

12.20 Of the 24 possible locations for the plant, fourteen sites were identified before the constraints were developed, nine during the development of the constraints and only one after the constraint mapping had been completed.

12.21 Consumers' witnesses testified that the Haldimand-3 site had been identified and visited by a member of Consumers' real estate division in September, 1984, before the SENES site selection study began.

12.22 Of the 24 potential sites, 11 sites, in an area stretching from Port Hope to Kingston, appeared to meet the map constraints. They were further assessed during a brief one-day visit by members of the site selection team. As a result of this tour, 5 sites were eliminated on the basis of site specific concerns.

12.23 Special Counsel argued that the hurried inspection of 11 sites was inconsistent with sound site selection methodology. He further argued that mapping distortions, which may have occurred when data were transferred from source maps, at a scale of 1:50,000, to the site selection documents which were at a scale of

1:100,000, may have eliminated other potentially good sites.

12.24 Counsel for Consumers' replied that Dr. Gorber had testified that some of the consultants had visited several of these sites prior to the one-day field trip. He also argued that the evidence had been that 1:50,000 scale maps had been used for the constraint mapping and these maps had been reduced to 1:100,000 scale only for reproduction in the Phase I report.

12.25 Special Counsel, the CCH and Mrs. Forbes, argued that the first stage of the site selection process was seriously flawed. They argued that no evidence was produced during the hearing to quantify the increased costs of designing the plant for a seismic Zone 2, even though the evidence indicated that an LNG facility had been designed and built in British Columbia in a location with higher seismicity (Zone 3). Consequently, they submitted that the eastern limit of the study area could have been extended east of Kingston.

12.26 Although Consumers' witnesses agreed that the farther east the LNG facility was located the better the diversification of supply it would provide for eastern Ontario and Canada, they did not explore the increased costs of designing a facility for a seismic Zone 2 location.

12.27 Similarly, the CCH submitted that no evidence was adduced to support Consumers' claim that land values and availability were more favourable east of Port Hope. Special Counsel and the CCH also postulated that good potential sites might have been overlooked because of Consumers' requirement that the site be located within 2 km of a 115 kV transmission line.

12.28 The CCH submitted that Consumers' rejected reasonable alternative sites on arbitrary decisions and that:

- o the population constraint did not bring into scrutiny further plans for development which would affect population growth;
- o public lands were not investigated as possible sites;
- o industrial sites were not specifically sought;
- o acquirability of land was obviously a factor in the decision making but it was not identified anywhere in the report as an influence on the selection process; and

- no further evidence was adduced to substantiate the requirement that the facility be located within 7 km of the TCPL pipeline.

12.29 Mrs. Forbes submitted that many potential sites were eliminated or overlooked in this initial stage for unsound reasons citing, for example, visibility of the storage tank from Highway 401 as an inadequate reason for eliminating certain potential sites.

12.30 Other intervenors, Mrs. Dorothy Ripley and Mr. and Mrs. Keith Savage, argued that the LNG facility should be located in an industrial area. Mrs. Ripley pointed out that industrial uses were not planned for the Haldimand-3 area because of its scenic beauty. Mr. and Mrs. Savage wanted to know why an industrial location had not been sought if an LNG plant is as safe as the company purported.

12.31 At the completion of Phase I, Consumers' report was released to the public. A public meeting was held in March, 1985, and comments were encouraged with respect to the methodologies used and the sites chosen for further study. Other sites were suggested by members of the public but these sites were subsequently examined and rejected by the consultants on the basis of the mapping constraints.

12.32 In addition to public input, comments on the report were also requested from the Ontario Pipeline Coordination Committee (OPCC). Consumers' submitted that the ministries and government agencies represented on the OPCC had been consulted regularly during the course of the Phase I program but did not raise any concerns with the site selection process. However, the evidence clearly shows that many concerns were expressed by Board staff regarding the site selection methodology.

Phase II - Selection of a Preferred Site

12.33 Phase II of the site selection process comprised a further, in-depth, assessment of each of the six candidate sites, followed by a comparison of the relative merits of each site.

12.34 The six sites evaluated in Phase II were:

- Haldimand-3;
- Haldimand-4;
- Cramahe-1;
- Cramahe-2;
- Brighton-1; and
- Brighton-2.

12.35 These sites are located within Northumberland County in an area north of Highway 401, beginning about 10 km east of Cobourg, at the Haldimand-3 site, and extending for about 22 km to the Brighton-2 site. Figure 12B shows the six candidate sites.

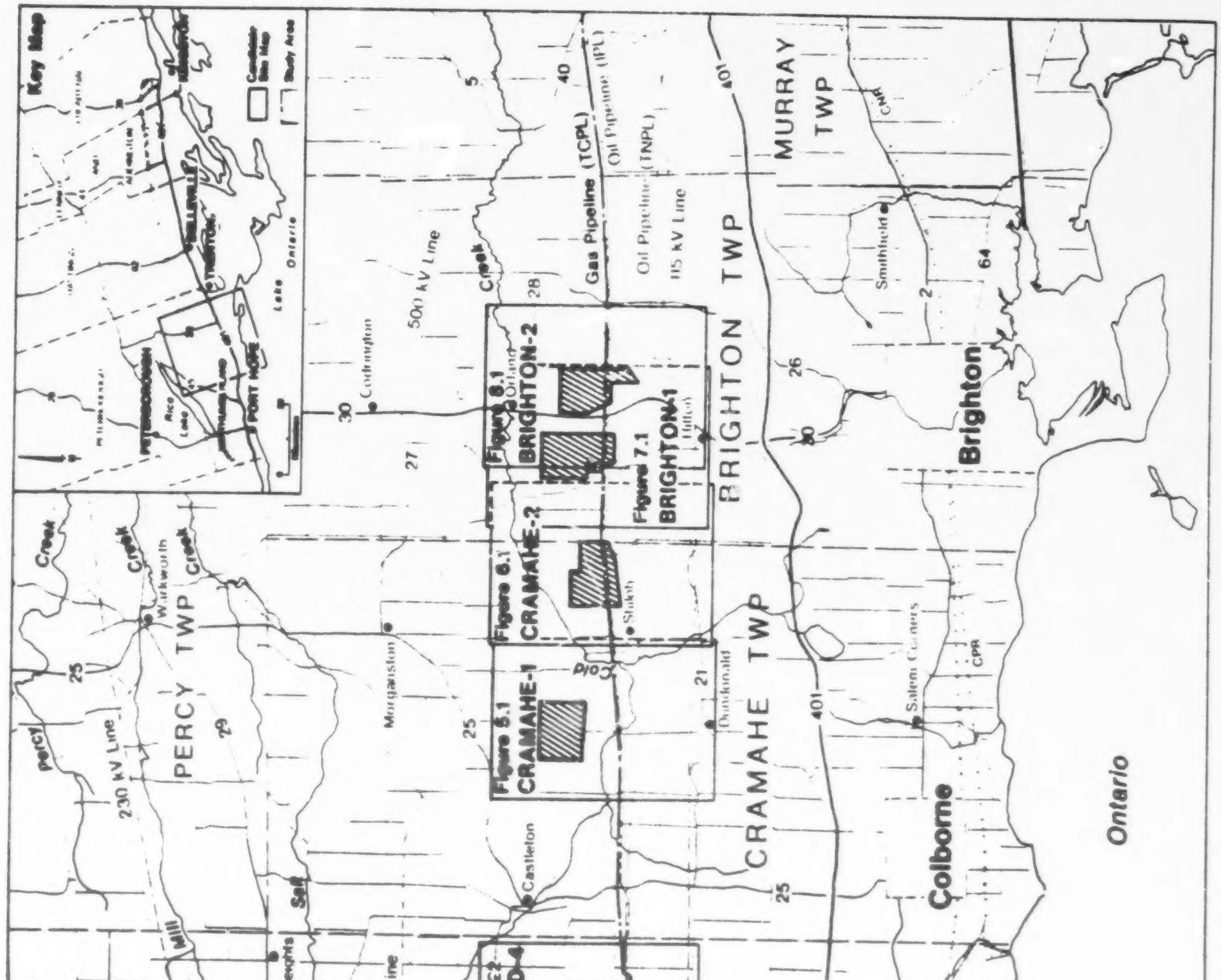
12.36 The methodology employed for the evaluation and comparison of the six sites was a four-step process, beginning with the development of four general categories for each site, including natural environment, socio-economic and cultural environment, site engineering and public safety.

12.37 Within each of these four general categories a number of sub-categories were developed by the specialists in the appropriate disciplines. For example, for the section assigned to the socio-economic and cultural environment, each site was examined in terms of the social and community setting, land use, agriculture, heritage and aesthetics, and economic setting.

12.38 Under each of these categories a number of measures were evaluated. For instance, within the social and community setting component there were five measures, including:

o number of people outside the cleared zone but within 2 km of the preliminary location;

o surrounding community system within 5 km, 10 km and 20 km;


Key Map
PETERBOROUGH
Rice Lake
PORT HOPE
BELLEVILLE
TRENTON
Lake Ontario
Candidate Site Map
Study Area
ALNWICK TWP
PERCY TWP
HALDIMAND TWP
CRAMAHE TWP
BRIGHTON TWP
MURRAY TWP
Rice Lake
Alderville
Fenella
Burnley
Oak Heights
Warkworth
Bomanton
Centreton
Eddystone
Carmel
Vernonville
Castleton
Morganston
Dundonald
Codrington
Orland
Hilton
Grafton
Wicklow
Colborne
Salem Corners
Brighton
Smithfield
Brookside
Percy
Creek
Mill
Salt
Cold
Valley
230 kV Line
500 kV Line
115 kV Line
Oil Pipeline (TNPL)
Gas Pipeline (TCPL)
Oil Pipeline (IPL)
CNR
CPR
401
Figure 3.1 HALDIMAND-3
Figure 4.1 HALDIMAND-4
Figure 5.1 CRAMAHE-1
Figure 6.1 CRAMAHE-2
Figure 7.1 BRIGHTON-1
Figure 8.1 BRIGHTON-2
N
Lake
Ontario
0
3
6
Kilometres
45
29
25
22
23
21
2
26
27
28
30
5
40
64
28

- lengths of roads to access the site from Highway 401;
- ratio of households that have registered concerns within 2 km and 3.5 km; and
- number of residents displaced.

12.39 The results of the evaluation of the measures yielded a component grade of Good, Fair or Poor. For the social and community setting example, Haldimand-3 obtained a grade of Good, Haldimand-4 and Cramahe-1 grades of Poor, and the remaining three sites were graded Fair.

12.40 This process was repeated for the six sites under the other categories of land use, agriculture, heritage and aesthetics, and economic setting. When grades had been assigned for each of the categories, an overall component grade was assigned to each site. For instance, Haldimand-3 obtained a grading of Fair for land use, Good for agriculture, Good for heritage and aesthetics, and Good for economic setting. This resulted in an overall component grade for Haldimand-3 of Good for socio-economic and cultural environment.

12.41 The measures were not weighted or ranked and the conclusions on the ratings reflected the judgment of the consultant, along with the results of discussions held with other members of the project team and Consumers' staff.

12.42 When the sub-categories had been graded, the resulting component grades were integrated into an overview matrix of all six sites for comparison. Each site was then ranked as Acceptable, More Acceptable or Preferred, based on the component grades assigned in the earlier evaluation.

12.43 At the conclusion of Phase II of the investigations, the consultants had identified both Cramahe-1 and Haldimand-3 as the best of the six sites and, therefore, these sites were ranked as the Preferred sites.

12.44 Mr. Riedl testified that Consumers' considered the Haldimand-3 site to be slightly better than Cramahe-1 and it was therefore selected as the site for which the Phase III environmental assessment would be performed (see Chapter 13). The reasons for this decision were that Consumers' was of the view that Haldimand-3 would remove less agricultural land, would provide easy access from Highway 401, on sparsely populated roads, and would offer more flexibility in locating the plant because of the site's natural topography. Consumers' announced its decision to proceed with the Haldimand-3 site in July, 1985.

12.45 The rationale for the types of questions used in the Phase II evaluation and for the ranking of the results was, in the opinions of Special Counsel and others, flawed, for it relied upon extensive application of the arbitrary judgment of the proponent's experts. Consequently, the process, in their view, provided the opportunity and the environment for Consumers' to select the preferred site of its choice or to justify a site that was chosen before the site selection process was instituted. Mrs. Forbes submitted that the Haldimand-3 site was chosen because it was "cheap, available, and close to Highway 401".

12.46 Counsel for Consumers' argued that the process of assessment and evaluation was professionally developed and executed. He submitted that there was no evidence to support the proposition that there had been a preconceived plan to support the choice of Haldimand-3 as the preferred site.

12.47 Consumers' witnesses testified that a proposed government regulation would require that an evacuation plan be filed along with any application for approval of an LNG facility. For this reason the population constraint, with respect to a 2 km radius from the plant, had been established in order to inconvenience as few residents as possible in the event of an emergency.

12.48 However, during the course of the proceedings the Board learned that an expansion to the number of campsites at the Shelter Valley Trailer Park and certain provisions in the Grafton Secondary Plan, could substantially increase the number of people who would be living within the 2 km range. These factors were not considered in assigning a grade of Good to the Haldimand-3 site when assessing it in the population and land use category.

12.49 In addition, the ratio of households that registered concerns with each site after the announcement of the project in March, 1985, was used as an evaluation measure for each site. Special Counsel submitted, however, that local concern, in the early stages of the proposal, was overemphasized. Furthermore, the evidence indicated that certain residents who might be most affected by the project on the Haldimand-3 site, did not receive notice of the project and, therefore, did not have the opportunity to express their concerns.

Findings and Recommendations

12.50 The Board is of the view that, although the site selection process appeared exhaustive, a closer examination revealed weaknesses in the mechanisms used and a good deal of arbitrary interpretation of the data.

12.51 The Board is of the opinion that an entirely different set of possible sites might have been identified had the criteria for a good site been established and then followed by a search for a site to fulfill the criteria. For example, such criteria might have, in a very specific way, identified possible sites in industrial areas or in more isolated surroundings. These sites then might have been evaluated with regard to availability, relative costs of construction, accessibility and environmental impacts.

12.52 The Board is of the view that the rationale for the boundaries of the study corridor is not persuasive. The lack of documentation with respect to land costs and availability and with respect to construction costs on sites east of Kingston leads the Board to question whether a site could have been acquired in areas, other than in the study corridor, that would have met Consumers' needs in a cost-effective manner.

12.53 The Board is of the view that the mapping constraints were arbitrarily developed and applied. For example, industrial areas should have been identified as desirable locations; the 7 km from the TCPL pipeline constraint eliminated almost all possibility of finding an isolated location; the need for a location within 2 km of a 115 kV transmission line was not proven from a cost or environmental point of view and may have eliminated potentially good sites in unpopulated areas; and consideration should have been given, not only to present land uses, but also to future land use policies in municipal official plans.

12.54 The Board finds it inconsistent, for instance, that although population density was a mapping constraint in Phase I, no attempt was made during Phase II to assess the impact of current development applications or local planning policies on future population densities around and close to the site.

12.55 The Order in Council directed the Board to have regard to the six candidate sites considered by Consumers'. In the Board's view, any examination of those six sites would be meaningless and of no value in its deliberations, if the Board were not persuaded that the candidate sites represented the results of a responsible process.

12.56 An examination of alternatives is a widely accepted, fundamental part of any comprehensive planning process and, indeed, Consumers' must have agreed with that principle or it would not have taken such pains to document its site selection process.

12.57 Moreover, the fact that Consumers' completed its Phase II report and commenced its environmental assessment of Haldimand-3 at about the same time that the OPCC began to review the report, implies that the preferred site selection was made in the absence of government input, and with little input from other sources.

12.58 The Board's overall conclusion relative to the Phase II Preferred Site Selection Process is that it could be interpreted to be one where a preselected site was simply justified by a subjective evaluation. Although Haldimand-3 may prove to be a good site, there are no assurances that a better site might not have been selected as a result of a more objective and comprehensive analysis, including: (a) a positive approach which would describe the attributes, in a generic sense, of a good site; and (b) the opportunity for consultation and input from interested parties with respect to the evaluation criteria.

12.59 In view of the foregoing, the Board recommends that, in the event that the LNG project proceeds, the company should be required to reassess its site selection process and address the inadequacies as found by this Board.

13. ENVIRONMENTAL IMPACT ASSESSMENT

I. Environmental Impacts of Consumers' Proposed LNG Facility

13.1 Consumers' chose Haldimand-3 as the preferred site for the LNG facility. The site is bounded on the west by County Road 23 and on the south by Chalet Road. The Eddystone Drumlin, a locally significant, geological feature, occupies the northwestern 40 ha of the site. The drumlin is heavily wooded and there is also a smaller woodlot comprising approximately 12 ha in the east-central section of the site.

13.2 The TCPL pipeline is located in an easement approximately 1.9 km north of the site boundary and a 115 kV transmission line located 0.8 km north of the site. There is also a 44 kV transmission line located 4 km south of the site.

13.3 Phase III of the environmental assessment process involved a detailed study of the Haldimand-3 site, beginning with site engineering to determine where the plant and its various components would be positioned. The assessment included a description of the engineering required to prepare the site and to construct the plant, as well as the operating characteristics of the facility. Once the exact location of the facilities had been determined, field work was conducted to assess the existing environment in order that the engineering plans could be superimposed on the existing conditions to determine the impacts of construction and operation.

Topography and Surficial Geology

13.4 Dr. Reades, on behalf of Consumers', described the investigations undertaken by his firm, Golder Associates (Golder), to assess the geology of the site. He testified that the conclusions from their investigations, which included drilling 43 bore holes to examine the sub-surface soils, were that the construction of the facility would not affect the drumlin and there would be minimal changes to the local topography. There was no evidence of aggregate resources to be protected. Further, Golder could foresee no particular problems with the bearing capability of the soils for the structures planned. No adverse impacts were anticipated as a result of the operations of the plant.

Meteorology, Air Quality and Noise

13.5 Dr. Koczkur testified on behalf of Consumers', that the dust generated by the construction activities at the site could be controlled by using generally accepted methods and by limiting the area under construction at any one time.

13.6 There would be emissions of carbon monoxide, oxides of nitrogen, hydrocarbons and suspended particulate matter during vapourization which would occur during seven to ten days a year. Calculations performed for these emissions indicated that provincial standards would not be exceeded.

13.7 Dr. Koczkur stated that the background measurements for noise on the site ranged from 40 decibels at night to 47 decibels during the day. Construction noise levels have been estimated and are predicted to fall below provincial guidelines. Consumers' has undertaken to limit construction activities to daylight hours, one shift daily, Monday to Friday, to the extent possible. During operations, the highest noise levels would occur during the vapourization period and even then are predicted to cause no increase in off-site background noise levels.

Surface Water

13.8 Mr. Stone, on behalf of Consumers', described the existing surface water drainage on the site and the projected impacts of the LNG facility on drainage. He recommended appropriate mitigation measures and a storm water management plan.

13.9 The only drainage system likely to be affected by Consumers' proposal is Grafton Creek, which flows southward through the site from its point of origin in a wooded valley to the north. Contributing flows from the site enter the creek through several intermittent channels.

13.10 The Ministry of Natural Resources (the MNR) has classified Grafton Creek as a good quality, cold-water trout stream. Various species of fish were collected at four sampling stations established along the creek. Water samples were also collected at various points in the creek and, upon analysis, the water quality was found to be below the maximum acceptable levels for the protection of aquatic life and for human consumption.

13.11 During the early stages of site preparation, Consumers' submitted that, in order to protect Grafton Creek from siltation, a sedimentation pond would be constructed immediately downstream of the construction area. Also, construction activities would be phased so that the amount of soil exposed at any one time would be minimized. Once the plant is in operation, the sedimentation pond and soil conservation practices would, in Mr. Stone's opinion, control erosion rates to below the present levels.

13.12 Mr. Stone testified that Grafton Creek or other surface water drainage systems on the site would not be impaired during either construction or operation if the proposed storm water management plan was implemented.

13.13 The CCH expressed concern that the trout streams would be impaired by the construction and operations of the LNG facility. Other parties, including Special Counsel and the MNR, appeared satisfied that the recommended storm water management plan would provide sufficient protection for the stream.

Groundwater

13.14 Consumers' plans to take approximately 61,000 m^3 of water from on-site wells to hydrostatically test the tank after it is fabricated but before it is used to store any LNG. After the test period, Consumers' intends to discharge this water to two reservoirs on the site which would retain the water for fire protection purposes. In addition, a domestic water supply would be needed during construction and operation of the plant.

13.15 Dr. Reades testified that the water needed for the tank testing could be pumped over a period of 17 to 18 months. A pumping rate of approximately 75 litres per minute (L/min) would be required. An additional 20-25 L/min would be necessary to provide drinking water and water for cleaning, and other general purposes during the construction period. Water demand is expected to drop to the 20-25 L/min range during the operation of the facility.

13.16 Golder conducted a three-stage water supply development investigation. The first stage comprised the assessment of the potential for obtaining groundwater to supply the LNG facility requirements. The consultants concluded from the interpretation of the geotechnical, bore-hole data and from their own test drilling, that there were two aquifers present on the site. An upper aquifer was found at a depth of 65 to 70 m and a lower aquifer was identified in the upper 6 m of the limestone bedrock, located 100 to 120 m below the surface. The bedrock aquifer appeared to have the potential to provide sufficient water for Consumers' needs without significant off-site interference.

13.17 Stage II of the investigations included drilling two bedrock water wells on the site and 72-hour pumping tests at a rate of 68 L/min. Existing MOE water well records were reviewed to augment information obtained by a door-to-door survey conducted within 1.5 km of the site during Stage I. A number of off-site and on-site wells were monitored during the pumping test, and water samples from the upper and lower aquifers were analyzed for water quality.

13.18 The Stage II study established that the bedrock aquifer could provide a water supply for the LNG requirements at a rate of approximately 150 L/min, with minimum potential for off-site interference. The water quality met government guidelines and no effects were observed on off-site wells during the pumping test.

13.19 Stage III of the investigation was instituted as a result of the concern expressed by local residents that their water supplies might be affected by the proposed Consumers' wells. This stage included a pumping test at a rate of 270 L/min over a period of 106 hours. The results verified and exceeded the Stage II results and indicated that the acquifer could supply more than 364 L/min, indefinitely.

13.20 Detailed chemical analyses were conducted on water samples from 15 wells in the vicinity of the site, both before and after the pumping test. In addition, MOE water well records for bedrock wells within 10 km of the site were reviewed.

13.21 The evidence indicated that the majority of domestic and farm wells in the area draw their water from the upper aquifer and there are no known users of the bedrock aquifer within 3 km of the site. Based on a geological examination of the site, the consultants concluded that the upper and lower aquifers are separated by more than 40 m of soils of low permeability. Therefore, the consultants were of the opinion that the Consumers' wells in the bedrock would not adversely affect the neighbourhood water supplies.

13.22 In its overall conclusions, Consumers' submitted that there was a more than adequate water supply to meet all stated LNG facility requirements and essentially no potential for off-site interference with private well quality or quantity.

13.23 Golder proposed a conceptual monitoring plan to verify the predictions made during the investigation of water supply potential. According to the plan, a network of 15 wells located within 5 km and including all bedrock wells within 2.5 km of the site would be monitored for six months prior to pumping, once a week for the first month of pumping and at monthly intervals, thereafter. The closest bedrock well to the Haldimand-3 site would be monitored by means of a continuous recording device in order to assess natural, daily changes in water levels.

13.24 During pumping tests, there had been complaints of well interference from some of the area residents. Those wells were monitored during later pumping tests which were conducted at higher rates and Consumers' indicated that they were not affected by factors related to the pumping.

13.25 Gartner Lee Associates (Gartner) was engaged to perform an independent review of the work performed by Golder. They were in agreement with the methodology used by Golder and the interpretation of the geology and hydrogeology of the site. Gartner also agreed that there would be a more than adequate water supply for Consumers' needs and that there would be no measurable effects on either quality or quantity of the groundwater in private wells in the local area. It also concurred with the proposed plan for monitoring local wells.

13.26 Owners of land adjacent to the proposed site expressed concerns about the possible contamination of their wells or hydraulic impacts on their supply, both for household and livestock purposes. Mr. Hinton argued that six wells had been affected by the pumping tests. Since Consumers' would not admit the influence of the tests on local wells, he submitted that a law suit against the company would probably be necessary to obtain compensation or redress if well impacts were experienced in the future. He further argued that the Golder report revealed that there were permeable layers within the clay till separating the two aquifers. He contended that, as a result, there could be a draw-down caused by Consumers' pumping from the deep aquifer. Mr. Hinton also argued that the proposed well-monitoring plan was inadequate.

13.27 The MOE and Special Counsel accepted the results of the Consumers' investigations as valid, although Special Counsel emphasized that the well-monitoring program must be undertaken if the project should proceed and Consumers' must provide water to landowners in the event of an interruption in water supply.

Vegetation and Wildlife

13.28 Dr. Muller investigated the flora and fauna of the site on behalf of Consumers'. This included a search of published literature and interviews with representatives of the MNR and local conservation authority officials as well as others with specific knowledge of the area. He also conducted a number of field surveys on the site including a detailed examination of 35 plots of 3 square metres each and a migratory bird survey during September and October of 1985.

13.29 Dr. Muller indicated that 32 per cent of the site is in agricultural use, 29 per cent in old fields, 8 per cent in tree row vegetation and 26 per cent in woodlot. He found that the MNR had designated the Eddystone Drumlin as significant in terms of natural and scientific interest. He also concluded from his literature search and field work that there were no rare or endangered species on the site.

13.30 In Dr. Muller's opinion, construction of the facility would have minimal impact on the terrestrial biology. The primary effect would be the new habitat created in the cleared zone. In fact, the drumlin would be better protected from hunting and tree cutting in accordance with MNR policy regarding natural woodland areas.

13.31 Since the surveys demonstrated that the site is not a major concentration point for migratory birds, the anticipated impact of the project was determined to be small. The tank would be about the same height as the drumlin, would not be brightly lit at night and would have no guy wires, all of which indicated to Dr. Muller that the tank would not cause significant bird kills. Further, Dr. Muller anticipated no impact on such species as deer or fox.

13.32 Mr. Hinton argued that the migratory bird survey conducted by Consumers' consultants, had been inadequate and there were, in fact, hundreds of birds attracted to the local habitat during migration periods. He was of the opinion that the wildlife patterns would be prejudiced by the noise, lighting and visibility of the proposed facility.

Agriculture

13.33 Consumers' indicated that the project would remove a very small amount of agricultural land from production. It based its opinion on a soils map which illustrated the results of an extensive soil sampling program conducted over the site. It also examined agricultural capability maps for the area and assessed the existing uses of the soils.

13.34 Consumers' concluded that of the 30 ha in the designated clear zone, 0.6 ha were Class 1 soils, the most valuable for agriculture purposes, and 3 ha were Class 2. These areas are not now in agricultural production. Other agricultural areas on the remainder of the site which are currently in production would continue to be worked. Consumers' submitted that agricultural impacts would be minimal.

Socio-economic and Cultural Environment

13.35 Mr. Keir testified, on behalf of Consumers', that during the construction of the facility, up to 120 jobs would be created over a period of about 5 months. He predicted that most workers would commute to the job from larger centres, although 20 to 30 families might move into the communities of Cobourg or Port Hope as a result of the employment opportunities created by the project.

13.36 At the peak of the construction phase, there would be a 20 per cent increase in traffic on County Road 23.

13.37 When the plant is in operation, 15 staff members, working in shifts, would be required at the site. In addition to the workers travelling to the plant, there would be 5 to 10 trucks per month going to and from the facility. The result is projected to be a net maximum increase of 3 per cent in the annual daily traffic on the section of County Road 23 from Highway 401 to the site.

13.38 The Haldimand Township Official Plan designation for the site is "rural" with the exception of three small parcels on the site which are designated as "environmental control" areas. The Zoning By-law recognizes the designations of the Official Plan and in addition designates a small woodlot in the northeast quadrant as an "environmental control" area. The municipality has approved amendments to these planning documents which would allow the LNG facility to proceed. These amendments would require the approval of the Ontario Municipal Board (the OMB) if the project is to proceed.

13.39 Since there was a great deal of concern with the visual impact of the tank on the local community, Consumers' lowered the tank height from 50 m to 40 m. In addition, it performed a study to determine the visibility of the tank from adjacent residential properties, local roads and other areas in the community. The consultants used photography and transects to plot the visual impact on aerial photographs and topographical maps in order to develop what they termed a "viewshed" map. Consumers' then used the map to develop on-site and off-site landscaping plans to block the views of the tank.

13.40 Special Counsel argued that the visual impact of the LNG facility could only be further mitigated by the selection of a site in a less populated area with better topographical relief.

13.41 Mr. Keir testified that an inventory of all the heritage sites within a 4 km radius of the tank had been conducted. No sites or locations of historical significance that would be affected by the facility were identified.

13.42 Mr. Keir also examined the economic impact of the project on the local and provincial economies. He testified that 17 per cent of the total capital budget would be spent locally, with about 77 per cent of that percentage spent on labour and about 12 per cent on materials. The project would be expected to provide approximately 100 to 120 man-years of employment to the county and an area within one hour driving distance from the site. There would also be significant impacts on the federal and provincial economies from the perspective of direct and indirect employment opportunities created and increases in domestic output.

13.43 The operations phase of the project would create 15 full-time jobs with preference given to local applicants. The annual operating budget, in excess of $3 million, would also contribute to the local, provincial and national economies.

13.44 Based on an assumed assessment of $1 million for the plant, Mr. Watson, Consumers' economic consultant, calculated that the municipal taxes paid by Consumers' for the LNG facility would have been $459,000 had it been in operation in 1986. These taxes would have caused a decline of about $10.00 in property taxes for each residential unit in the township in that year.

13.45 Mr. Watson concluded that there would be a provincial benefit as well, since provincial grants are related to the local assessment. Consequently, about 66 per cent of Consumers' taxes would accrue to the provincial government by way of unpaid grants to the municipality. There would also be some resulting decrease in taxes for other taxpayers in the county and school board jurisdictions.

13.46 Consumers' direct payments to Haldimand Township would have an even more significant impact since they would include $325,000 for parkland, road allowance and related fees and $250,000 to cover the costs of upgrading Chalet Road. These direct payments would provide an opportunity for the municipality to establish a reserve fund, to increase the capital works programs, and to stabilize tax increases. The total increase in spending by the township, county and school board, as a result of the project, was estimated to be about $44,000.

13.47 Mr. Watson concluded on the basis of his investigations that the project would have positive implications for the municipality and he was unable to identify any negative financial impacts.

Monitoring Programs and Undertakings

13.48 Consumers' intends to follow the recommendations of the various consultants for monitoring programs and mitigation measures. These would include the hiring of an independent environmental inspector to monitor the environmental procedures on the site and to ensure that mitigation measures and other commitments of the company were being carried out. Although the plan was to have an independent inspector report to the project director, Consumers' agreed with suggestions made during the hearing that the inspector should report to a management official of the company who was not directly involved with the project.

13.49 Consumers' submitted a list of undertakings made in the environmental reports including mitigation measures and monitoring procedures to minimize environmental impacts during the construction period and over the long-term operation of the plant. The company agreed to include requirements for these measures and procedures in all applicable construction contracts and operating manuals. It also agreed to file with the OEB and Haldimand Township interim and final monitoring reports during and after the construction phase and to make such reports available to the public.

Land Values

13.50 Consumers' submitted that the LNG facility would have no adverse impact on land values in the vicinity of the project and therefore proposed no compensation policy covering property devaluation. In support of its position, the company outlined several factors for the Board's consideration.

13.51 Consumers' tabled a report describing a survey conducted in April, 1986, of the attitudes of residents, local officials and businessmen living in proximity to the LNG facility in Laporte, Indiana. Of the householders interviewed, some expressed concern over property values but admitted that they had no evidence of any impact. Laporte real estate brokers interviewed were of the view that the facility had not affected local real estate values. The operator of a trailer camp located 3.5 km from the Laporte facility did not indicate concern with the facility and told the interviewers that a recent appraisal of a local trailer park had not indicated that the LNG facility had any impact on the value of the property. Recent purchasers in the area believed they had paid premium prices for their properties.

13.52 According to the report, however, "about half of the [householder] respondents stated that if given the choice, they would prefer to have the plant located elsewhere, primarily because it would eliminate any potential concerns evident now or possible in the future."

13.53 In April, 1985, Consumers' commissioned an independent appraisal of property values regarding the lands adjacent to four of the six candidate sites. Properties in the vicinity of the Haldimand-3 site were included as part of this study. In addition, the appraiser examined the values of property around the LNG facilities located at Hagar, Ontario, and owned by ICG.

13.54 The conclusions of the Hagar appraisal, where the LNG facility have been in place since 1968, were that there appeared to have been no measurable effect on the market value of residences in the vicinity of the plant that could be attributed to the plant. In fact, the majority of the homeowners in the area had purchased or built after the plant was in place.

13.55 Counsel for Consumers' argued that effective measures would be taken to eliminate or minimize such factors as plant visibility, noise and air emissions that might affect property values.

13.56 Further to a resolution of the Township Council, Consumers' has agreed to discuss and attempt to resolve the concerns of four named landowners that their properties might be devalued by the project, and report to Council within two months of receiving all regulatory approvals. Mr. Riedl suggested that if the Township were not satisfied with the report it could withhold the building permit for the project.

13.57 Mrs. Shirley Johnston, on behalf of the Citizens for Progress and Development in Haldimand, testified that the project would not affect property values and that, in fact, it might stimulate real estate activity in the area. She pointed to the fact that two new homes had been built within 1.5 km of the site since the announcement of the project and that two others had "sold well". She submitted a letter from a local real estate agent stating his opinion that the LNG installation would have no affect on real estate values in the Township or in the immediate area.

13.58 Residents in the immediate vicinity of the preferred site did not accept Consumers' conclusion with respect to property values. Mr. Sawyer, the son of the owners of the Shelter Valley Trailer Park, testified that he believes the facility would adversely affect the park.

13.59 Mr. David Pritchard, owner of eight acres of property located north of the site, testified that he had not been able to sell his property although it had been on the market for six months. He testified that a potential purchaser had lost interest in the property when he learned of Consumers' LNG project.

13.60 Mrs. Forbes argued that the LNG facility would mar the landscape and detract from the pastoral environment. In her opinion, if the project is approved, Consumers' should be required to negotiate a fair compensation with affected landowners who live within a set distance from the tank.

13.61 Mr. Hinton, for the CCH, also argued that the presence of the LNG facility would depreciate the value of local farms, homes and businesses.

13.62 Special Counsel argued that it does not seem realistic to assume that adjacent property values would not be affected and that it seemed likely that they would decline. He recommended that there should be financial compensation if the project was to proceed.

Government Concerns

13.63 The OPCC reviewed the Phase III environmental assessment report and found that most of the concerns expressed during the reviews of the earlier reports, had been addressed to its satisfaction.

13.64 The major outstanding concerns were raised by the MOE with respect to dispersion modelling, noise impacts and water-related issues. The issue of dispersion modelling has been addressed in Chapter 11 of this Report. According to the MOE submission to the OPCC, Consumers' would be required to obtain environmental approvals from the MOE for sewage works under the Ontario Water Resources Act and for air emissions under the Environmental Protection Act.

Noise

13.65 The MOE was concerned with the noise impact assessment conducted by Consumers'. It submitted that background noise assessment at the site had not been performed in compliance with proper scientific procedures. Subsequent to the testimony of the MOE's noise expert, Consumers' conducted further background noise evaluation at the site and filed the results as reply evidence. The new information resolved the MOE concerns with the exception that it would require further background noise assessments during the winter months to establish the lowest ambient noise levels.

13.66 The MOE noise expert submitted that construction equipment should be in compliance with the maximum criteria set out in Publication NPC-115 of the MOE's Model Municipal Noise Control By-law. Publication NPC-115 sets sound emission standards for various items of construction equipment according to the date of manufacture of that equipment.

13.67 The MOE also took the position that the potential noise impacts from the operating LNG facility should be addressed by incorporating sound level limits into the conditions of approval for the project. The appropriate criteria, according to the MOE witness, were to be found in Publication NPC-132, "Guidelines for Noise Control in Rural Areas" (NPC-132). This publication suggests sound level limits for stationary sources in rural areas where the acoustical environment is normally dominated by natural sounds and where road traffic, if any, is not frequent. The MOE argued that although there is some noise impact from traffic on Highway 401, the Haldimand-3 site should be considered a rural area and the more stringent NPC-312 criteria should be made a condition of approval.

Groundwater

13.68 The MOE agreed with the technical methodology used by Golder for its investigations of potential groundwater impacts. Further, the MOE found the consultants' conclusions, that there would be no adverse impacts on the groundwater regime, to be sound and reasonable.

13.69 The MOE informed the Board that Consumers' had applied for a water-taking permit as required by Section 20 of the Ontario Water Resources

Act. Approval must be given and a permit issued before the pumping proposed by Consumers' could be carried out.

Land Use Planning, Township of Haldimand

13.70 Counsel for the Township of Haldimand explained that the Township had adopted no position with respect to the site selection process but it was of the view that the Haldimand-3 site is a satisfactory site and that the OEB should recommend approval of the LNG facility.

13.71 The Township based its position upon the report of Mr. Walker who had examined the planning implications of the Consumers' proposal and the applications to the Township for amendments to the Official Plan and Zoning By-law to accommodate the development.

13.72 Mr. Walker had reported to the Township Council by way of a preliminary report in October, 1985, and a final report in February, 1986. The public had access to Mr. Walker's reports before they went to Council. Futhermore, Council meetings were open to the public.

13.73 The preliminary report identified certain issues that had not been adequately addressed by Consumers', specifically, storm water management, compatibility of the proposal with rural uses, aesthetics, services to the site, traffic and emergency access.

13.74 According to Mr. Walker, Consumers' subsequently provided additional information to the Township which either met the planning and environmental concerns or identified ways that these concerns could be resolved in a development agreement.

13.75 Mr. Walker's final report was tabled at a public council meeting in February, 1986 and its conclusions were that, although the existing Official Plan and Zoning By-law did not allow the proposed use, these planning documents could be amended with justification. The report discussed the outstanding issues and made recommendations as to how these matters could be addressed in the amendments and in the development agreement.

13.76 The Township approved the requested amendments to the Official Plan and Zoning By-law subject to the terms set forth in the Development Agreement signed by the parties on March 24, 1986. The agreement delineates conditions which include:

(1) a cash payment of $250,000 for improvements to Chalet Road;

(2) snow ploughing of specified sections of Chalet Road and County Road 23;

(3) water for the LNG facility to come from deep aquifer wells and that there be no interference with local water wells;

(4) on-site and off-site landscaping to eliminate any visual impact of the tank on views within a radius of 2 km of the site;

(5) the conveyance to the Township of one foot reserves around the perimeter of the site, except at designated access points;

(6) an emergency access;

(7) the extension of natural gas services to specified areas of the Township;

(8) payment of $50,000 in lieu of parkland dedication;

(9) a building permit fee of $200,000;

(10) payment for municipal fire protection service, if used, and a water outlet on site for the use of the local fire department;

(11) the purchase by Consumers' of unopened road allowances located on the site, if and when they are closed, for $75,000; and

(12) reimbursement of all of the Township's costs associated with the Official Plan and Zoning By-law amendments, including administrative, planning and legal costs.

13.77 The amendments to the Official Plan and Zoning By-law are to be referred to the OMB, although the OMB has been requested not to schedule a hearing pending the outcome of the OEB hearing.

13.78 According to Mr. Walker, the proposed amendments were not in conflict with the goals of the Official Plan and there would be no adverse effects on business and tourist interests in the area. Mr. Walker was of the view that the Consumers' proposal would not inhibit development in the area. To illustrate this point, he referred to a proposal currently before the Township Council for the approval of an expansion to the Shelter Valley Trailer Park, which is located southeast of the site. At the present time, the Park comprises 125 campsites and the owners have applied to the municipality for approval to extend the camping area and facilities to accommodate 90 more campsites. Their application was launched before the LNG proposal became known.

13.79 There are other areas slated for development within 2 km of the site. Adjacent to the south side of Highway 401 and southeast of the site, there are lands covered by the Grafton Secondary Plan which designates the area for residential use. Another area, south of the site and located in the northern section of the Hamlet of Grafton, includes at least 13 registered lots and a large acreage for a plan of subdivision which is currently in the approvals process.

13.80 Mr. Walker recommended that the location was suitable for industrial use, given its proximity to Highway 401 and County Road 23, and the site could be made compatible with the surrounding land uses through the terms of the Development Agreement. Mr. Walker did not believe development should be curbed in the vicinity of the site and claimed that the examples described above supported his view that business and tourism would not be adversely affected by the proposal.

II. Environmental Impacts of Union's Alternatives

13.81 Union's consultants conducted environmental assessments of the five transmission pipelines that would be needed for its proposed SPS. These environmental assessment reports were filed with the Board. Evidence was not adduced relative to the environmental impacts of the 35 injection/withdrawal wells, the increased horsepower at the compressor stations or the new gathering lines. At the time of the hearing, the OPCC had partially reviewed four of the pipeline studies but had not reviewed the environmental impact study of the Kirkwall to Hamilton pipeline, which would be required only for Alternative B.

13.82 The construction of the pipeline from the Bentpath-Rosedale Pool to the Dawn Station would directly affect 18 landowners. If easements cannot be negotiated, expropriation proceedings might become necessary. The most significant impact of the installation of this pipeline would be expected to be on the agricultural tile drainage systems in the area.

13.83 The construction of the pipeline from 167 Pool to the Dawn-Trafalgar transmission line would require two private easements, which have been negotiated, and the remainder of the route would be located within a road allowance. Little environmental impact is anticipated from the construction of this line.

13.84 The Strathroy to Lobo pipeline would traverse 18.2 km of prime agricultural land, on new easements which have yet to be negotiated. The line would cross twelve streams and minor water courses, two of which are considered to be significant. Union proposed to construct dry water crossings and specified construction and mitigation measures to control sedimentation impacts on a local trout farm. The pipeline would directly affect 42 landowners and the consultant has proposed extensive mitigation measures to avoid the loss of unique specialty crop soils. Also, construction would be scheduled to avoid, as much as possible, cropping periods. For the agricultural impacts of this and the other pipelines, Union plans to institute a crop-loss compensation plan. It also proposes to monitor local wells in order to detect and mitigate any impact on the water supplies, which may result from the pipeline construction.

13.85 The construction of the pipeline from the Brantford take-off to the Kirkwall valve site would affect 35 landowners. Easements have not yet been negotiated. Agricultural land along this section ranges from good to marginal. The construction of this pipeline would have significant impacts upon three businesses in the area, the Shaver Poultry Farm, the Bayus Trailer Park and the African Lion Safari. Union proposes to institute noise mitigation measures to decrease the impact on the poultry operation and to time the construction periods to minimize business losses at the Bayus Trailer Park and the African Lion Safari. The owners of these enterprises would be compensated for damages and business losses. This loop section would also include the crossing of ten streams, some of which are municipal drains. It is also expected to have some impact on a number of woodlots and hedgerows.

13.86 For the construction of the pipeline from the Kirkwall valve station to the Hamilton gate station, easements would be required from three landowners and the remainder of the line would follow an Ontario Hydro right-of-way. Permission would have to be obtained to locate the line on this right-of-way. There would be two stream crossings and a diversion around a significant wetland. For these and other environmentally sensitive areas, special mitigation measures have been proposed for implementation during the construction period.

13.87 In all cases, Union's experts testified that the routes chosen for the five pipelines were the best routes and there were no environmental matters that could not be remedied.

13.88 Special Counsel submitted that the Union SPS proposal would have significantly greater environmental impacts than the LNG proposal during the construction period. He argued, however, that these short-term impacts would be in the general area where pipeline facilities are in place and landowners are familiar with the expected impacts. On the other hand, the LNG proposal would have greater long-term, persis- tent impacts on a community that has had no experience with similar development.

13.89 Counsel for Consumers' argued that the Union proposal would have serious and substantial environmental impacts and that there was insufficient evidence before the Board with respect to the environmental implications. He emphasized that no evidence had been provided with respect to Union's proposed well-drilling program, the new compression facilities or the additional gathering lines that would be required. He argued that the environmental impacts of Union's alternatives would be much more severe than those of the LNG facility.

Findings and Recommendations

13.90 The Board is of the view that Consumers' has conducted a thorough assessment of the Haldimand-3 site and that the undertakings given by the company should be sufficient to prevent or mitigate adverse environmental impacts during the short-term construction period. The Board would incorporate these undertakings as Conditions of Approval if the project were to proceed.

13.91 The Board agrees with the submissions of the MOE with respect to noise impact assessment and control and would impose the requested conditions of approval if this project were to be approved. Such conditions would require construction equipment to be operated in compliance with the maximum sound levels set out in Publication NPC-115 and the plant operations to be subject to the noise level limits set out in Publication NPC-132.

13.92 Further, the Board is of the opinion that the Township of Haldimand has negotiated a comprehensive Development Agreement with Consumers', which would provide economic benefits to the municipality.

13.93 The Board does not agree with the submissions of Mr. Walker that the site can be made compatible with surrounding land uses. The community as it exists provides a rural setting for farming and bountiful natural attributes which have attracted residents and tourists to the area.

13.94 Neither does the Board agree with Mr. Walker's submission that this site is a logical choice for the LNG facility because of its proximity to Highway 401. To accept this principle would be to accept a proposal that industrial uses should override other land use designations along any highway within the province.

13.95 The Board is of the opinion that although Consumers' may be able to prevent or mitigate the short-term environmental impacts of the LNG project at the Haldimand-3 site, the mitigation of the long-term cultural impacts on the community may not be possible.

13.96 The Board agrees with Special Counsel that the facility should be located in a less populated area to minimalize visual impacts. The Board believes that the proposed facility is incompatible with present land uses and the future direction of the community's development. A site designated for industrial uses would be more appropriate.

13.97 Further, the Board is of the view that if the LNG project were to be approved, the values of some of the properties in the vicinity could be adversely affected. Consequently, any approval of the project should incorporate conditions with respect to the method of determining appropriate compensation.

13.98 The Board agrees with the submissions of Special Counsel that the Union SPS proposal could have significant construction-related environmental impacts which would be greater in the short-term than those caused by the LNG proposal. However, once the pipelines have been constructed, the long-term impacts would be insignificant. The Board is of the view that a much more detailed review by the OPCC would have to occur before the Union proposal could proceed and there would be the necessity for public hearings on the Union applications, at which time the environmental assessments would be thoroughly examined. Additional information would also be required with respect to the well-drilling program, the additional compression facilities and the gathering lines at the storage reservoirs.

14. PIPELINE FACILITIES

Introduction

14.1 As noted in Chapter 1, Consumers' will require two pipelines to connect the LNG facility to the TCPL system. An NPS 16 pipeline will be used to supply gas to the facility for liquefaction and to carry gas back to the TCPL pipeline during vapourization. An NPS 6 pipeline will be used to transport by-products and boil-off gas back to the TCPL system.

14.2 Consumers' considered four alternate routes for the pipelines. The preferred route for the two pipelines serving the LNG facility will begin at the proposed Consumers' valve station adjacent to the TCPL pipeline. The pipelines will then run south approximately 3,300 m along the east side of County Road 23 to a point approximately 550 m north of Chalet Road (Township road between Concessions I and II). They would then extend directly east approximately 500 m across the plant property line and into the LNG process area. Figure 14A shows the preferred route.

Design and Safety

14.3 Consumers' proposes to install these pipelines in the same trench. The NPS 16 pipeline will be placed 1.3 m below the surface and the NPS 6 pipeline will lie 0.3 m above it. The upper-most pipeline will therefore be placed at least 1 m beneath the surface.

14.4 While the method is unusual, as most pipelines are placed in separate trenches, Consumers' submitted that it meets, and in fact exceeds the requirements of CSA Standard Z184-M1983 (CSA Z184) which sets out the specifications for Gas Pipeline Systems.

14.5 Consumers' also proposes to install a continuous pipeline warning tape over the upper-most, NPS 6, pipeline to alert anyone inadvertently digging in the area to the presence of the pipelines. In addition, Consumers' will conduct weekly patrols to ensure proper security and maintenance of the pipelines.

14.6 The CCH and Mrs. Forbes expressed the concern that an accident along County Road 23 might

Figure 14A

The Preferred Route

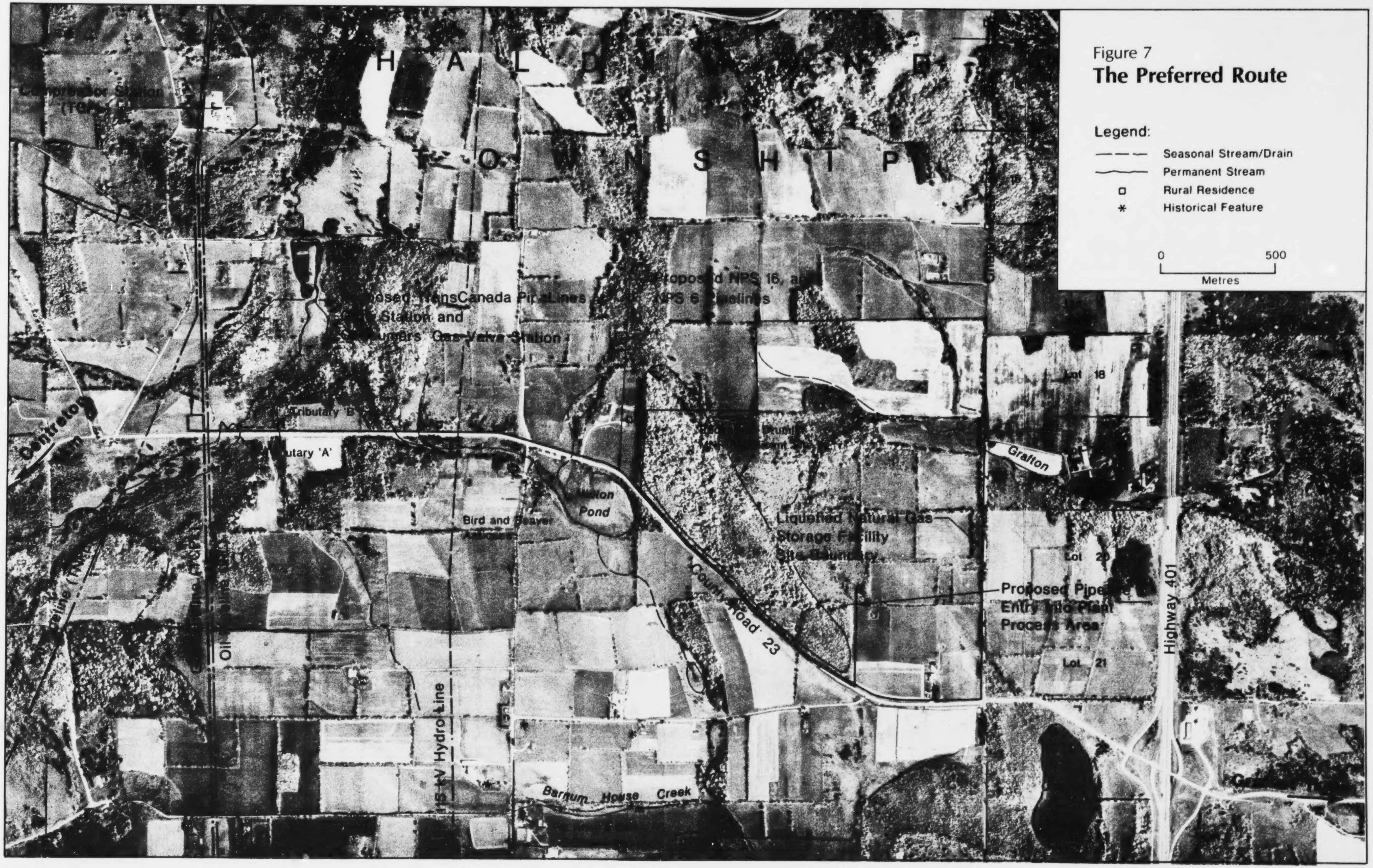

HALDIMAND
TOWNSHIP
Compressor Station (TCPL)
Proposed TransCanada PipeLines Station and Consumers Gas Valve Station
Proposed NPS 16, and NPS 6 Pipelines
Tributary 'B'
Tributary 'A'
Centreton
Bird and Beaver
Pond
Liquefied Natural Gas Storage Facility Site Boundary
Proposed Pipeline Entry into Plant Process Area
Lot 18
Lot 20
Lot 21
Grafton
County Road 23
Highway 401
Oil Pipeline
115 kV Hydro Line
Barnum House Creek
Legend:
Seasonal Stream/Drain
Permanent Stream
Rural Residence
Historical Feature
0
500
Metres

Figure 7
The Preferred Route

result in rupture of the pipelines and potential injury to members of the public and local residents. Consumers' submitted that the thickness of the walls of the proposed pipelines is greater than required by CSA Z184 and would, therefore, enhance safety. Special Counsel added that the depth of the ground cover along with the warning tape provide sufficient insurance to safely place the pipes along County Road 23. However, to ensure safety, he submitted that open trench during construction should not exceed 1 km at any given time.

14.7 Consumers' indicated that it proposes to install automatic valves which would isolate the pipelines from the process facilities to avoid damage or further problems in the process related facilities in the event of a loss of pressure in the pipelines. The final design of these valves, however, was not complete at the time of examination in the safety phase of the hearing.

Environmental Impact

14.8 Consumers' prepared an Environmental Report to assess the environmental impacts of the pipelines required to connect the LNG facility to the TCPL system. This Report consisted of a route selection study, in which the four alternate routes were considered, and an environmental impact assessment of the preferred route.

14.9 The four routes considered included: the West Route which ran along private easements; the East Route 1 which followed an Ontario Hydro easement and County Road 23; the East Route 2 which followed the same Hydro easement, privately owned land and a township road allowance; and the County Road 23 Route, as described above.

14.10 While the OPCC reviewed the Environmental Report, there was some initial disagreement among its members regarding the preferred route. The CCH submitted that the MNR and the MOE preferred the West Route in order to minimize the number of water crossings. Special Counsel noted, however, that the MAF preferred the County Road 23 Route due to its limited impact on farmland. Special Counsel submitted, further, that subsequent meetings between Consumers', the MNR and the MOE resolved these concerns in favour of the County Road 23 Route. In addition, he submitted that the comparative analysis employed by Consumers' in selecting a pipeline route is consistent with OEB Environmental Guidelines for the Construction and Operation of Hydrocarbon Pipelines in Ontario.

14.11 Consumers' indicated that the most significant potential environmental impact along the preferred route may occur at Shelter Valley Creek. Consumers' has therefore proposed a "dry" crossing of this watercourse. Crossings will be conducted in a "biological window" when cold water species are not spawning.

14.12 Special Counsel argued that any approval of this proposal must include a condition which restricts the crossing of Shelter Valley Creek to a period between June 15th and September 15th in any given year. He added that all mitigation recommendations contained in the pipeline contract specifications must be fulfilled before the facility is approved.

Findings and Recommendations

14.13 In summary, the Board finds that Consumers' has complied with OEB Environmental Guidelines for the Construction and Operation of Hydrocarbon Pipelines in Ontario.

14.14 The Board finds that Consumers' compliance with the CSA Z184 for the design, construction and operation of the pipelines in conjunction with certain precautions such as the warning tape and security patrols are sufficient to ensure the safe installation and operation of the pipelines.

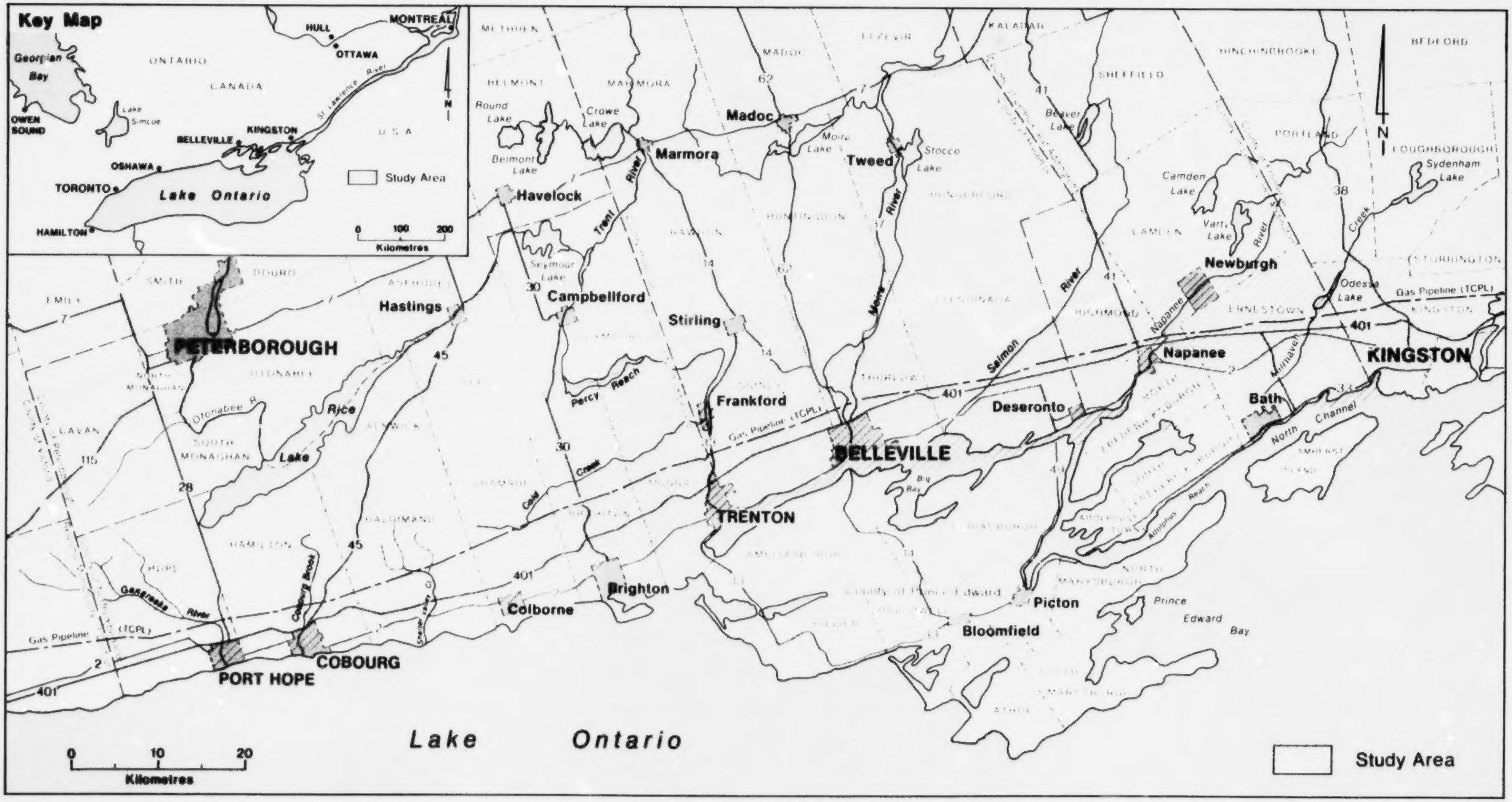
14.15 The Board is of the view that the final design of the proposed automatic valves should be examined and approved by the Fuels Safety Branch of the MCCR prior to their installation.

14.16 The Board finds that the route selection methodology used by Consumers' is sound and that the County Road 23 Route is an acceptable route for the proposed pipelines.

14.17 The Board is of the view that, in the event that the LNG facility is approved, the company must conduct a dry crossing of Shelter Valley Creek between June 15th and September 15th. Moreover, any leave to construct approval would be conditional upon all mitigation measures contained in the pipeline contract specifications being fulfilled.

14.18 The Board further recommends that, if the project is approved, open trench during construction should not exceed 1 km at any one time. This would help to avoid problems associated with soil erosion, trench sloughing and hazards to the public.

14.19 As the Board has previously recommended in this Report that the LNG project should not proceed, it will make a formal determination on the application by Consumers' for leave to construct the pipelines only in the event that its recommendations are not adopted by the Lieutenant Governor in Council, and His Honour approves the construction of the facility.


Key Map
Georgian Bay
OWEN SOUND
ONTARIO
CANADA
HULL
OTTAWA
MONTREAL
St. Lawrence River
Lake Simcoe
BELLEVILLE
KINGSTON
U.S.A.
OSHAWA
TORONTO
HAMILTON
Lake Ontario
Study Area
0
100
200
Kilometres
N
PETERBOROUGH
Hastings
Havelock
Campbellford
Marmora
Madoc
Tweed
Stirling
Frankford
BELLEVILLE
TRENTON
Deseronto
Napanee
Newburgh
Bath
KINGSTON
Brighton
Colborne
COBOURG
PORT HOPE
Picton
Bloomfield
Round Lake
Belmont Lake
Crowe Lake
Seymour Lake
Moira Lake
Stocco Lake
Beaver Lake
Camden Lake
Varty Lake
Odessa Lake
Sydenham Lake
Big Bay
Trent River
Moira River
Salmon River
Napanee River
Millhaven Creek
Rice Lake
Otonabee R.
Percy Reach
Cold Creek
Ganaraska River
Cobourg Brook
Shelter Valley Cr.
Adolphus Reach
North Channel
Prince Edward Bay
Gas Pipeline (TCPL)
401
Lake Ontario
0
10
20
Kilometres
Study Area
N

STUDY AREA Figure 3.1

15. SUMMARY OF FINDINGS AND RECOMMENDATIONS

Introduction

The following is a summary of the findings and recommendations of the Board relating to each phase of the hearing in respect of the proposed LNG facility.

The Need for Facilities

8.44 Given the timing of this proposal, the forecast of the future demand must, by necessity, be made in an extremely uncertain environment. Uncertainties regarding the price of natural gas resulting from the Agreement on Natural Gas Markets and Prices, the relative price of oil and the rate of conservation in the face of lower natural gas prices all contribute to the difficulty in forecasting natural gas sales. While forecasting annual demand may prove difficult in the face of these uncertainties, forecasting peak day demand is substantially harder. Consequently, forecasts of peak day demand ten years into the future are very speculative.

8.45 The Board is of the view that the normalized data do not support Consumers' contentions that its load factor is deteriorating and that it is developing a needle peaking characteristic. Moreover, it is clear that while the company's temperature sensitive market has increased, the effect appears to have been offset to some degree by conservation and other factors. The Board accepts that the figures advanced by Special Counsel are reliable and that, based on the results of the linear regression analysis, Consumers' load factor has actually improved over the period 1977 to 1985.

8.46 The Board is of the view that Consumers' has implicitly employed a 41 DDC condition for facilities planning purposes in this instance. The demand forecasts have been determined on the basis of weather conditions which are likely to occur much less frequently than indicated by the company.

8.47 The Board is of the view that the company's annual demand is increasing at an average rate of about 1.5 per cent per year, although year-to-year changes could be substantially above or below that level. A precise estimate of the forecast error cannot be made until the forecasting model has been tested for several years, without modification, against actual demand experience.

8.48 While the Board recognizes that all forecasts are subject to limitations with respect to their accuracy, the magnitude of the forecast errors identified by Special Counsel give the Board some cause for concern. If Consumers' industrial sales were to continue to exceed the forecast to the degree they have in the past two years, the load factor would continue to improve, contrary to the company's submissions.

8.49 The Board is of the view that demand management techniques have not been fully explored by the company. The Board recognizes that it is a clear advantage for a utility to construct facilities since a rate of return is earned on incurred costs. Load management techniques, on the other hand, do not earn a rate of return. Regardless of the volume of future peak day demand, the need may best be served by obtaining additional gas from underground storage together with emphasis on enhanced demand management techniques to encourage additional interruptible load.

8.50 The Board is of the view that the forecast of peak day demand has not stood up to critical analysis. While the Board finds that the forecasted peak day demand of 8,500 10^3m^3 in the period 1985 to 1994 has not been demonstrated, it is prepared to admit that, due to the complexity of the matter, it cannot state an alternative volume which would reasonably bear the test of time. Rather, contrary to the company's contentions, the forecast has consistently overestimated peak day demand and the load duration curves are not steepening. Therefore, the Board is of the opinion that Consumers' has not demonstrated that there exists a need for peak shaving facilities.

The Alternatives Considered by Consumers'

9.39 The Board is of the view that none of the alternatives considered by Consumers', other than the LNG facility, could singularly satisfy the perceived need.

9.40 Given the uncertainty of supply and the prohibitive cost, the Board concludes that the alternative of obtaining additional WPS from TCPL is not feasible. For the same reasons, no other alternative, or combination of alternatives, should rely on TCPL providing WPS in the future.

9.41 Further, the Board finds that the propane alternative is not suitable because it is incapable of meeting the perceived need. However, the Board recognizes that, if required, this alternative could prove to be a valuable demand management technique.

9.42 The Board is of the view that Consumers' evaluation of Tecumseh A, B and C did not necessarily reflect their true potential.

9.43 While the Board recognizes that Tecumseh C might have been a viable alternative, it is not included in the Board's deliberations, at Consumers' request, because of Union's acquisition of an option to purchase the Dow-Moore Pool.

9.44 While the LNG facility is capable of meeting the company's perceived need, in the interest of the public, the Board is of the view that Consumers' actual peak day demand may be best served by other means.

9.45 The Board finds that the criteria used to make the final selection ought to be in agreement with its mandate to "report to the Lieutenant Governor in Council on whether the Project is in the public interest." In this context, the term "public interest" means to the Board:

- to provide the service at the lowest possible cost to the Ontario consumer;

- to ensure that security of supply and system reliability and flexibility are maintained and enhanced; and
- to ensure that safety and environmental concerns are adequately met.

9.46 While the Board respects the judgment of Consumers' experienced management, in this instance, the public interest requires that the Board review other alternatives beyond those strictly within the control of Consumers' and confined in impact to Consumers' customers.

9.47 The Board, therefore, recommends that alternatives which have shorter planning and construction lead times, which allow for additional capacity in smaller increments and can be implemented economically to serve either peak day demand or demand over a broader time period, are preferable in an uncertain environment.

A Comparison of the LNG Facility and the Union Alternatives

10.63 The Board recognizes that the presence of competing alternatives has resulted in significant reductions in the estimated costs of each proposal, which can only benefit the Ontario gas user. In addition, favourable market conditions in the energy sector have made further cost reductions of the LNG facility possible. The Board finds that Consumers' $74.3 million capital cost estimate for the LNG facility is reasonable.

10.64 The Board finds that the capital costs of Union's Alternatives A and B, including IDC and excluding general overheads, estimated by Union to be $96.6 and $106.5 million, respectively, are also reasonable.

10.65 The Board finds that the average annual operating costs of the LNG facility are significantly higher than the average annual operating costs of either of the Union alternatives, as set out in Table 10.2.

10.66 The Board is of the view that for the purpose of comparing the various alternatives, an incremental cost methodology is appropriate and only costs incurred incrementally by either company in order to provide the peaking service should be included in the capital cost and NPV calculations. This is consistent with the Board's opinion that the public interest requires that all gas users in Ontario should enjoy the benefits, not just Consumers' customers.

10.67 The Board recognizes that under present tax law, the LNG facility falls under Class 2 CCA. The

Board, therefore, accepts that Class 2 is currently the appropriate basis upon which to compare the costs of the proposed facility.

10.68 The Board finds that the cost allocation methodology ought not to be a determinant when choosing among the various alternatives that will provide the same peaking service to Ontario gas users. Under its mandate, the Board must ensure that costs are allocated to gas users fairly and equitably. This function must be accomplished within its annual rate-setting hearings for each utility, and not in advance.

10.69 More specifically, the Board finds that general overheads and the 4 Bcf cushion gas carrying cost should be excluded from Consumers' calculation of Alternative A, as neither represent an incremental cost to Union's system.

10.70 The Board further finds that, for cost comparison purposes, the mid-year discounting method is acceptable and that the cost adjustments made by Consumers' are appropriate, with the exception of the overhead adjustment of $6.4 million. This should have been adjusted upward to approximately $6.7 million to reflect mid-year discounting, and not downward to $5.7 million as suggested by Consumers'.

10.71 The Board is of the view that an inflation-adjusted price of gas is a realistic assumption and accepts Consumers' correction for the cost of Alternative A as reasonable and appropriate.

10.72 The Board considers that an adjustment to IDC of $1.4 million should be added to the NPV of Union's calculation of the cost of Alternative A.

10.73 The Board finds that the residual value ought to be included in Consumers' NPV calculation. The Board finds, therefore, that an amount of $6.3 million should be properly added to Union's incremental cost calculation.

10.74 The Board is of the opinion that the Union alternatives will likely result in higher operating efficiency on its transmission system. The fuel cost savings, therefore, constitute a legitimate cost reduction. The Board finds that a net savings of $6.6 million in compressor fuel over a period of twenty years of service for Alternative A, as adjusted by Consumers', is reasonable and acceptable.

10.75 As the LNG facility will not be in service for the winter of 1988-89, Consumers' will incur costs of approximately $1.8 million for 1 Bcf of WPS from TCPL during that period. The Board is, therefore, of the view that this additional expense should be added to the cost of the LNG facility.

10.76 While the Board recognizes that sunk costs may be addressed in subsequent rate hearings, in this instance, it is of the view that the sunk costs of approximately $5 million, incurred by Consumers', should not be treated as incremental to the costs of Union's alternatives.

10.77 The Board is of the opinion that, for cost comparison purposes, the NPV of the LNG facility is $169.8 million and the NPV of Union's Alternative A is $155.2 million. Alternative B is not included in the Board's adjusted cost comparison as it was removed from consideration when it became apparent that the costs of its implementation were excessive.

10.78 Table 10.3 summarizes the adjustments that the Board finds appropriate for cost comparison purposes.

Table 10.3

Adjusted Cost Comparison
(in millions of 1988 dollars)

	LNG	Alt. A	Alt. A
Total NPV at 10% discount(A)	168.0(B)	149.0(C)	198.5(D)
Overhead adjustment		(6.7)	(6.7)
4 Bcf adjustment			(36.2)
TCPL swap costs and 2 Bcf carrying cost		11.8	
Interest during construction		1.4	
Residual		6.3	
Commodity charge		(6.6)	
Peaking service	1.8		
TOTAL	169.8	155.2	155.6

(A) As adjusted by Consumers' for mid-year discounting.

(B) Based on Consumers' update using a Class 2 CCA tax treatment.

(C) Based on Consumers' revision to Union's update of its incremental costs to Ontario.

(D) Based on Consumers' revision to Union's update of its incremental costs to Consumers' customers.

10.79 The Board finds that in terms of security of supply, both Alternative A and the LNG facility will enhance the security of Ontario's natural gas system. However, the Board is of the view that the underground storage alternative provides a substantial quantity of cushion gas which, in an emergency situation, may be used. This is not the case with the LNG facility. Therefore, the Board is of the view that, from a provincial perspective, Union's Alternative A constitutes a more secure and reliable source of supply than the LNG facility.

10.80 The Board is of the opinion that from a provincial perspective, the public interest requires that the Board consider not only ownership and operational control but also which alternative is best for Ontario.

10.81 In addition, the Board finds Union's alternative to be more flexible as it will have shorter planning and construction lead times, will allow for additional capacity in smaller increments and can be implemented economically to serve either peak day demand or demand over a broader time period.

10.82 Therefore, the Board concludes that, from a provincial perspective, Union's Alternative A is preferrable to the LNG Project.

Design and Safety of the LNG facility

11.90 The Board is of the view that Consumers' has demonstrated that the technology exists to permit the construction and operation of the proposed LNG facility within an acceptable level of safety. The plant, however, must incorporate proper safety features and meticulous attention must be given to quality control to prevent the creation of undue risk to the public.

11.91 The Board is satisfied that the design of the storage tank selected by Consumers' is acceptable as it meets or exceeds the requirements of the codes and standards involved. The evidence indicates that the use of 9 per cent nickel steel for the construction of the inner tank is appropriate as its properties are well understood in the industry and it is able to withstand the cryogenic temperature of LNG.

11.92 Although the bottom connection and external pump arrangement is commonly used, the Board is of the view that the top connection and in-tank pump should be incorporated into the design of the LNG storage facility.

11.93 The Board is also of the view that the staged dike design proposed by Consumers' is acceptable, but that the final detailed design ought to be further assessed by independent experts before final approval is obtained.

11.94 The Board is of the opinion that Consumers' has not supplied sufficient evidence in respect of the final detailed design of the entire facility. The Board recommends that this information should be made available prior to any final certification. This applies particularly with respect to the design of the process facilities and control room, the location of the refrigerants on the site, and most importantly, in respect of the emergency planning procedures to be followed in the event of a major incident.

11.95 The Board is of the view that quality assurance and quality control at the proposed facility have been responsibly and thoroughly addressed. However, it recommends that all quality assurance and quality control files relating to the operation of any LNG facility should be open to scrutiny by an independent, private sector or government inspector rather than by an internal, high-ranking company official.

11.96 The Board is in agreement with the evidence of Dr. Brown and Dr. Napier in respect of the modelling used to calculate the vapour cloud dispersion and separation zones. While it is apparent that there is a difference of scientific opinion, the Board is of the view that, for the purposes of this hearing, the HEGADAS II model used by Consumers' is acceptable for predicting the dispersion of LNG vapour clouds.

11.97 The Board recommends that in the future a staged approval process similar to that which exists in the United Kingdom and some jurisdictions in the United States should be adopted in Ontario with respect to future applications to construct LNG facilities.

11.98 The Board recommends that in the future a public hearing should take place to address the need for the facility, the alternatives to meet that need, the site selection process, the environmental impact assessment, and the general design of the facilities. If satisfied that these concerns have been effectively addressed, approval in principle should follow.

11.99 Subsequently, the detailed design drawings and specifications of the facility should be submitted to the MCCR for review and comment. If satisfied, a permit to construct the facilities should be issued in accordance with CSA Z276 and CSA B51. In the final stage, the construction, inspection, certification and intermittent monitoring of the facilities should become the responsibility of the Fuels Safety Branch of the MCCR.

11.100 The Board strongly recommends that CSA Z276 be enacted as a regulation under the Energy Act as proposed to ensure that the powers of the Fuels Safety Branch are legally enforceable with respect to the design, construction and operation of an LNG storage tank and process facilities. In addition, once passed, the regulation should be regularly amended to reflect the advances and improvements in the design and construction of LNG facilities.

11.101 Furthermore, in the Board's view, it is imperative that experts with knowledge of LNG technology and hands-on experience with LNG plants be retained by the Fuels Safety Branch to evaluate proposals for LNG facilities and to monitor their operation.

11.102 The Board is of the opinion that this review and approval process will adequately ensure that a plant and its related facilities are designed and constructed in a manner that reflects certified safety features and adheres to a high standard of quality control in all phases of the project.

The Site Selection Process

12.50 The Board is of the view that, although the site selection process appeared exhaustive, a closer examination revealed weaknesses in the mechanisms used and a good deal of arbitrary interpretation of the data.

12.51 The Board is of the opinion that an entirely different set of possible sites might have been identified had the criteria for a good site been established and then followed by a search for a site to fulfill the criteria. For example, such criteria might have, in a very specific way, identified possible sites in industrial areas or in more isolated surroundings. These sites then might have been evaluated with regard to availability, relative costs of construction, accessibility and environmental impacts.

12.52 The Board is of the view that the rationale for the boundaries of the study corridor is not persuasive. The lack of documentation with respect to land costs and availability and with respect to construction costs on sites east of Kingston leads the Board to question whether a site could have been acquired in areas, other than in the study corridor, that would have met Consumers' needs in a cost-effective manner.

12.53 The Board is of the view that the mapping constraints were arbitrarily developed and applied. For example, industrial areas should have been identified as desirable locations; the 7 km from the TCPL pipeline constraint eliminated almost all possibility of finding an isolated location; the need for a location within 2 km of a 115 kV transmission line was not proven from a cost or environmental point of view and may have eliminated potentially good sites in unpopulated areas; and consideration should have been given, not only to present land uses, but also to future land use policies in municipal official plans.

12.54 The Board finds it inconsistent, for instance, that although population density was a mapping constraint in Phase I, no attempt was made during Phase II to assess the impact of current development applications or local planning policies on future population densities around and close to the site.

12.55 The Order in Council directed the Board to have regard to the six candidate sites considered by Consumers'. In the Board's view, any examination of those six sites would be meaningless and of no value in its deliberations, if the Board were not persuaded that the candidate sites represented the results of a responsible process.

12.56 An examination of alternatives is a widely accepted, fundamental part of any comprehensive planning process and, indeed, Consumers' must have agreed with that principle or it would not have taken such pains to document its site selection process.

12.57 Moreover, the fact that Consumers' completed its Phase II report and commenced its environmental assessment of Haldimand-3 at about the same time that the OPCC began to review the report, implies that the preferred site selection was made in the absence of government input, and with little input from other sources.

12.58 The Board's overall conclusion relative to the Phase II Preferred Site Selection Process is that it could be interpreted to be one where a preselected site was simply justified by a subjective evaluation. Although Haldimand-3 may prove to be a good site, there are no assurances that a better site might not have been selected as a result of a more objective and comprehensive analysis, including: (a) a positive approach which would describe the attributes, in a generic sense, of a good site; and (b) the opportunity for consultation and input from interested parties with respect to the evaluation criteria.

12.59 In view of the foregoing, the Board recommends that, in the event that the LNG project proceeds, the company should be required to reassess its site selection process and address the inadequacies as found by this Board.

Environmental Impact Assessment

13.90 The Board is of the view that Consumers' has conducted a thorough assessment of the Haldimand-3 site and that the undertakings given by the company should be sufficient to prevent or mitigate adverse environmental impacts during the short-term construction period. The Board would incorporate these undertakings as Conditions of Approval if the project were to proceed.

13.91 The Board agrees with the submissions of the MOE with respect to noise impact assessment and control and would impose the requested conditions of approval if this project were to be approved. Such conditions would require construction equipment to be operated in compliance with the maximum sound levels set out in Publication NPC-115 and the plant operations to be subject to the noise level limits set out in Publication NPC-132.

13.92 Further, the Board is of the opinion that the Township of Haldimand has negotiated a comprehensive Development Agreement with Consumers', which would provide economic benefits to the municipality.

13.93 The Board does not agree with the submissions of Mr. Walker that the site can be made compatible with surrounding land uses. The community as it exists provides a rural setting for farming and bountiful natural attributes which have attracted residents and tourists to the area.

13.94 Neither does the Board agree with Mr. Walker's submission that this site is a logical choice for the LNG facility because of its proximity to Highway 401. To accept this principle would be to accept a proposal that industrial uses should override other land use designations along any highway within the province.

13.95 The Board is of the opinion that although Consumers' may be able to prevent or mitigate the short-term environmental impacts of the LNG project at the Haldimand-3 site, the mitigation of the long-term cultural impacts on the community may not be possible.

13.96 The Board agrees with Special Counsel that the facility should be located in a less populated area to minimalize visual impacts. The Board believes that the proposed facility is incompatible with present land uses and the future direction of the community's development. A site designated for industrial uses would be more appropriate.

13.97 Further, the Board is of the view that if the LNG project were to be approved, the values of some of the properties in the vicinity could be adversely affected. Consequently, any approval of the project should incorporate conditions with respect to the method of determining appropriate compensation.

13.98 The Board agrees with the submissions of Special Counsel that the Union SPS proposal could have significant construction-related environmental impacts which would be greater in the short-term than those caused by the LNG proposal. However, once the pipelines have been constructed, the long-term impacts would be insignificant. The Board is of the view that a much more detailed review by the OPCC would have to occur before the Union proposal could proceed and there would be the necessity for public hearings on the Union applications, at which time the environmental assessments would be thoroughly examined. Additional information would also be required with respect to the well-drilling program, the additional compression facilities and the gathering lines at the storage reservoirs.

Pipeline Facilities

14.13 In summary, the Board finds that Consumers' has complied with OEB Environmental Guidelines for the Construction and Operation of Hydrocarbon Pipelines in Ontario.

14.14 The Board finds that Consumers' compliance with the CSA Z184 for the design, construction and operation of the pipelines in conjunction with certain precautions such as the warning tape and security patrols are sufficient to ensure the safe installation and operation of the pipelines.

14.15 The Board is of the view that the final design of the proposed automatic valves should be examined and approved by the Fuels Safety Branch of the MCCR prior to their installation.

14.16 The Board finds that the route selection methodology used by Consumers' is sound and that the County Road 23 Route is an acceptable route for the proposed pipelines.

14.17 The Board is of the view that, in the event that the LNG facility is approved, the company must conduct a dry crossing of Shelter Valley Creek between June 15th and September 15th. Moreover, any leave to construct approval would be conditional upon all mitigation measures contained in the pipeline contract specifications being fulfilled.

14.18 The Board further recommends that, if the project is approved, open trench during construction should not exceed 1 km at any one time. This would help to avoid problems associated with soil erosion, trench sloughing and hazards to the public.

14.19 As the Board has previously recommended in this Report that the LNG project should not proceed, it will make a formal determination on the application by Consumers' for leave to construct the pipelines only in the event that its recommendations are not adopted by the Lieutenant Governor in Council, and His Honour approves the construction of the facility.

Recommendation

Based on these findings and recommendations the Board is of the view that the LNG storage facility is not in the public interest. The Board recommends, therefore, that Consumers' proposal to construct the project should not be approved.

16. COST AWARDS

Intervenor's Costs

16.1 The intervenors applying for costs incurred through participating in this hearing are the CCH and Mrs. Forbes.

16.2 In the Report on the Awarding of Costs and Related Procedural Matters E.B.O. 116 (the Cost Report), the Board concluded that cost awards may be made to an intervenor who:

a) has or represents a substantial interest in the proceeding to the extent that the intervenor or those it represents will be affected beneficially or adversely by the outcome;

b) participates responsibly in the proceeding; and

c) contributes to a better understanding of the issues by the Board.

16.3 In the Cost Report, the Board added that while costs may be available for all legitimate expenses incurred in the preparation and presentation of an intervention, these costs must be reasonable and must have been incurred directly and necessarily for the purposes of the respective hearing.

16.4 The Board is of the view that the intervenors seeking costs did attempt to address most of the issues before the Board. The Board accepts that these intervenors have met the above criteria and are, therefore, eligible for cost awards.

16.5 Mrs. Forbes submitted that based on the time she spent preparing interrogatories as well as the time she spent preparing for and attending the hearing, she ought to receive an honorarium which reflected her contribution to the proceeding. In addition, she claimed actual disbursements for travel, postage and photocopying.

16.6 The CCH submitted that it ought to receive certain costs in relation to the participation in the hearing of its representatives, Messrs. Hinton and Dix, as well as its legal counsel, Cassels, Brock and Blackwell. Mr. Hinton sought an honorarium in respect of the time he spent consulting with experts, conducting research, preparing for and attending the hearing, and preparing documents and argument. In addition, he claimed certain disbursements for travel.

16.7 Mr. Dix also requested an honorarium in relation to the time he spent researching, consulting, preparing for and attending the hearing, and preparing exhibits and argument. In addition, he claimed disbursements for supplies used in preparing exhibits and for travel. The Board notes that Mr. Dix is a professional engineer and a member of the Geological Association of Canada.

16.8 The CCH also submitted a separate claim for expenses incurred for research, overhead, transcripts, and for photocopying and printing exhibits and argument.

16.9 Counsel for the CCH claimed costs, on behalf of the CCH, relating to legal fees and consultants' fees, primarily in respect of the site selection phase of the hearing. In addition, they seek to recover certain amounts relating to miscellaneous disbursements and transcript costs.

16.10 In accordance with the foregoing, the Board awards to Mrs. Forbes, the following honorarium: for her participation in the hearing for 39 days at $50/day, $1,950.00; and for preparation of her argument, $150.00. For her disbursements, the Board awards the amount of $401.30, as claimed. This amounts to a total cost award of $2,501.30 to Mrs. Forbes.

16.11 To Mr. Hinton, on behalf of CCH, the Board awards the following honorarium: for his participation in the hearing as a representative, 25 days at $50/day, $1,250.00; and for the preparation of argument, $150.00. This amounts to a cost award of $1,400.00.

16.12 To Mr. Dix, on behalf of the CCH, the Board awards the following honorarium: for his participation in the hearing as a representative, 7 days at $50/day, $350.00; for general consultation to the CCH, $125.00; and for preparation of argument, $50.00. This amounts to a cost award of $525.00.

16.13 The costs awarded to Messrs. Hinton and Dix reflect the fact that the CCH was also represented by counsel for a specific phase of the hearing.

16.14 Since the disbursements claimed by Messrs. Hinton and Dix, as representatives of the CCH, and the disbursements claimed to have been directly incurred by the CCH, are much greater than those claimed by Mrs. Forbes, the Board is of the view that they should be subjected to the Board's assessment process as set out in the Cost Report. Supporting documentation for all expenses claimed shall be submitted to the Board for examination and assessment by the Assessment Officer.

16.15 The costs claimed by counsel for the CCH shall also be examined and assessed by the Assessment Officer.

16.16 Therefore, Messrs. Hinton and Dix, as representatives for the CCH, the CCH, and counsel for the CCH, on or before January 9, 1987, shall submit to the Board and Consumers', a statement of costs verified by an appropriate affidavit. Following assessment, an order shall be issued directing that these costs, as fixed at that time by the Board, shall be paid by Consumers'.

16.17 In relation to the intervenors' reasonably incurred costs, as fixed herein, a cost order will be issued directing Consumers', within 10 days of the release of this Report, to make the following payments:

a)	to Mrs. Lynda Forbes	$2,501.30
b)	to the Concerned Citizens of Haldimand Township (re: Mr. Hinton)	$1,400.00

c) to the Concerned Citizens of Haldimand Township (re: Mr. Dix) $525.00

The Board's Costs

16.18 The Cost Report also addressed the question of who should pay costs and under what circumstances. The Board concluded as follows:

a) generally, the cost awards resulting from proceedings before the Board should be borne by the applicant;

b) subject to (c), in references the issues affect many of those in the regulatory process and "ordering costs to be paid by customers of the utilities would generally not be justified";

c) but where a particular participant in a reference stands to benefit from the reference, the Board may in its discretion require that participant to pay costs; and

d) the Board will continue to charge its costs to an applicant utility and in a reference, where a participant obtains benefits or relief of some nature, the

Board may recover its costs from those who benefit.

16.19 In addition, subsection 28(2) of the Ontario Energy Board Act provides that the "Board may order by whom and to whom any costs are to be paid ..."

16.20 The Board is of the opinion that, in this instance, the responsibility for the payment of the Board's costs should be distributed between the two utilities participating in the hearing. The Board finds that, as both utilities were in a position from which they might benefit as a result of the hearing, an equitable distribution requires that Consumers' bear 80 per cent and Union 20 per cent of the Board's costs and expenses of and incidental to this proceeding as soon as they are fixed.

Appendix A

GLOSSARY OF TERMS

ACCEPTABLE RISK	A value of public risk associated with a project at which the risk is usually considered to be acceptable. Where industrial operations are concerned, this value is commonly a chance of less than 1 in 1,000,000 per year of a public fatality due to a plant accident.
AMBIENT	Pertaining to the natural conditions (or environment) at a given place and time.
AMORTIZATION	A systematic writing-off of an investment or expenditure over a period of time.

ANNUAL CONTRACT QUANTITY SERVICE (ACQ)	A long-term gas from TCPl service which usually provides for an annual quantity of gas to be deliverable 40 per cent in winter and 60 per cent in summer with various curtailment provisions. This allows the transmission company to use its facilities more efficiently. ACQ service is normally used by customers who have suitable storage facilities.
ANNUAL LOAD FACTOR	The annual load factor is a mathematical indicator of the way in which a customer consumes gas over the year. Although it may be expressed in different ways it is often defined as the average daily volume of gas which a customer uses divided by the maximum daily volume used or contracted for.
AOI	See Authorized Overrun Interruptible Service.
ATMOSPHERIC DISPERSION	Mixing of substances above sea level such as waste heat and combustion products.
ATMOSPHERIC STABILITY	The change in ambient temperature with height which defines the potential of the

	atmosphere to disperse airborne emissions. (See Pasquill D and Pasquill F)
AUTHORIZED OVERRUN INTERRUPTIBLE SERVICE (AOI)	An interruptible gas service from TCPL which is available at the discretion of the seller only after its daily contractual obligations have been met.
BASE YEAR (BASE PERIOD)	An historical period (usually the most recent fiscal year for which actual data are available) used as the starting point in determining rates for a future test year. Also known as the historical year.
BOIL-OFF	The evaporation of liquefied gas into gas vapour as a result of natural heat gain into the tank containing the liquid.
CAPITAL	The total funds invested in a company by lenders (debt capital) and by owners (equity capital).
CAPITAL BUDGET	A plan (or tentative committtment of funds) which may be expended during a test year on major items such as plant and equipment usually having a useful life exceeding one

	year. Such amounts are likely to become part of rate base.
CAPITAL COST ALLOWANCE (CCA)	Deduction from income allowed with respect to certain fixed assets used in carrying on a business. CCA is similar in nature to depreciation used for accounting purposes. However, unlike depreciation, the rates allowed are prescribed by income tax regulations and are not intended to reflect an asset's useful service life.
CLEARED ZONE	A cleared area between a facility and the nearest trees or shrubs, sized to prevent a fire at the facility from spreading to the nearest trees or bushes.
CONTRACT DEMAND (CD)	A firm (i.e. non-interruptible) gas service from TCPL which provides gas up to a specific maximum daily quantity. The buyer must pay a monthly demand charge regardless of the volumes taken and a commodity charge for the volumes actually taken. (See "Demand Charge")
COST ALLOCATION	The allocation of a utility's capital costs and operating costs among customer classes.

	It is used as a guide in designing rates to recover those costs in an equitable manner.
CLASS 1 LAND	A land capability class description for agricultural use. Soils in this class have no significant limitations in use for crops.
CLASS 2 LAND	Soils in this class have moderate limitations that restrict the range of crops that can be grown or that require moderate conservation practice.
COST OF SERVICE	The total cost of providing service, including operating and maintenance expenses, depreciation, amortization, taxes and return on rate base. Generally, the cost of service of a pipeline is the same as its "revenue requirement".
CRYOGENIC	Relating to a low temperature process or operation.
CSA	Canadian Standards Association.

CURTAILMENT	A reduction in gas consumption resulting from requests by a utility to certain interruptible customers who normally have dual fuel capability.
CUSTOMER CLASSES	The grouping of the customers of a utility.
CUSTOMER LOAD	The total amount of gas used by a customer in a fixed period of time.
DEFERRED INCOME TAXES	The amount by which income taxes, determined on the basis of accounting income, exceeds income taxes payable. Deferred income taxes are either carried on the balance sheet of a company as a liability or disclosed in a footnote to the financial statements. (See "Normalized Income Taxes", "Flow-through Income Taxes" and "Capital Cost Allowance".)
DEGREE DAY CELSIUS (DDC)	An expression used to describe a given level in temperature. It is calculated by assuming a plateau of 18 degrees celsius. One degree day is counted for each degree of average daily temperature below 18 degrees celsius.

DEMAND CHARGE	A monthly charge which normally covers the fixed costs of a pipeline. The demand charge is based on the daily contracted volumes and is payable regardless of volumes taken.
DESIGN GROUND MOTIONS	Representations of earthquake ground motion in forms suitable for use in the structural or geotechnical design process.
DESIGN PEAK DAY	The sendout expectation at design weather conditions.
DESIGN SPILL	A series of spills of hazardous liquids defined by CSA Z276. The hazards associated with a design spill must be confined within a proposed public safety zone.
DISPERSION	The distribution or dilution of a given quantity of a substance in an increasing volume of atmosphere, regulated mainly by the intensity of the turbulent mixing of the air.
DISTRIBUTION PLANT	The equipment, pipelines, meters, etc., used by the utility to distribute gas to customers.

DIVERSIONS	A diversion occurs when gas is delivered at a different delivery point than contracted for. Such a diversion is generally undertaken to assist in the balancing of a transmission system or of supply and demand.
DRY CROSSING	A method of installing a pipeline across a watercourse whereby the water flow is carried across the proposed pipeline location by a flume (culvert) and trenching is done under the flume in the "dry" streambed.
DUAL FUEL CAPABILITY	A customer's capacity to use alternative fuels in the same application or end use.
EARTHQUAKE RECURRENCE INTERVAL	Probable number of years between earthquakes having a specific strength.
EASEMENT	An interest in land owned by another which entitles the holder to a specific limited use.

FEEDSTOCK	Natural gas used as a process raw material or chemical "building block", and not as a source of energy.
FIXED ASSETS	Assets such as land, buildings, equipment, and machinery, which are acquired for use in the operation of a business and are not intended for resale.
FLASH GAS	Natural gas vapour produced during liquefaction to aid in refrigeration of the liquefied natural gas.
FLOW-THROUGH INCOME TAXES	A method of estimating income taxes payable for a period. This estimate is based on actual taxable income, as opposed to an income tax provision based on income for financial reporting purposes. (See "Deferred Income Taxes" and "Normalized Income Taxes".)
FORCE MAJEURE	A contract clause intended to excuse one or more parties from their obligations under a contract, in situations where performance is frustrated by unusual and severe circumstances such as flood, fire, war or prolonged labour strike.

GEOTECHNICAL INVESTIGATION	Any method used to determine subsurface soil conditions. Boring a hole and examining the resulting cores is the most common method used.
HECTARE	A unit of area in the metric system equal to 10,000 square metres or 2.471 acres.
HERITAGE RESOURCES	Resources that are of historical note because of their architectural, archeological, or aesthetic merits, or because they are associated with some historical personage or event.
HYDRAULIC COMMUNICATION	The ability of water to move freely from one distinct soil or rock formation into another.
HYDROGEOLOGY	The science of the occurrence, movement, exploitation, geochemistry and management of groundwater resources.
IMPOUNDMENT AREA	An area that may be defined through the use of dikes or the topography at the site, for the purpose of containing any accidental spill of a potentially hazardous liquid.

INTANGIBLE PLANT	The utility's investment in intangible assets such as franchises, patents, copyrights, and goodwill
INTEREST DURING CONSTRUCTION	A means that accountants use to recognize and allocate the interest cost of capital funds employed during the construction period. This procedure assumes 100 per cent debt financing during construction.
INTERRUPTIBLE CUSTOMER	A customer whose gas service is subject to interruption at the discretion of the utility. This type of customer is typically required to have a dual fuel capability in the event of interruption.
ISOPACH	A line joining points of equal thickness of an underground deposit or formation on a geological map.
JOINT VENTURE	An arrangement between persons, partnerships, associations or corporations to share in an undertaking.

LATERALS	Pipelines that tie into a trunk line and are generally part of either a gathering or distribution system. (See "Trunk Lines".)
LIQUEFACTION	The process of converting a gas or a vapour to a liquid, usually by cooling.
LIQUEFIED NATURAL GAS (LNG)	Natural gas in the liquid state composed predominantly of methane and which may contain minor quantities of ethane, propane, nitrogen or other components normally found in natural gas.
LNG VAPOUR CLOUD	Cloud of natural gas and air formed when LNG is released into the air. If a vapour cloud forms, it will be carried and dispersed by the wind.
LOAD DURATION CURVE	A graph of daily sendout (ranked from smallest to largest) and the number of days duration of each load level.
LOAD FACTOR	The ratio of average day to peak day gas consumption, expressed as a percentage.

LOAD OCCURRENCE CURVE	A graph of daily sendout and day of year in chronological order.
LOWER FLAMMABLE LIMIT (LFL)	The minimum concentration of a flammable gas in air which can be ignited. For natural gas the LFL is 5 per cent.
MANOMETER	A pressure measuring device which employs a column of fluid which rises and falls depending on the magnitude of pressure exerted on it with respect to atmospheric pressure.
MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP)	The highest internal pressure allowable during the operation of a specific gas pipeline; varies from one pipeline to another depending principally on the strength of the pipe. MAOP is determined by Regulation O. Reg. 450/84 which adopts, in part, specification CSA Z184-M1983 of the Canadian Standards Association.
METRIC TERMS	10^3m^3 = one thousand cubic metres 10^6m^3 = one million cubic metres

10^9m^3 = one billion cubic metres

METRIC CONVERSION FACTORS

1 cubic foot of natural gas (@ 14.73 psi and 60°F) = 0.028 327 84 cubic metres

1 cubic metre (m^3) of natural gas = 35.301 cubic feet

1 Mcf (@ 14.73 psia) = 28.327 84 m^3

1 MMcf (@ 14.73 psia) = 28 327.84 m^3 or 28.327 84 10^3m^3

1 Bcf = 28 327 840 m^3 or 28.327 84 10^6m^3

$1 \times 10^3m^3$ = 35.301 Mcf

$1 \times 10^6m^3$ = 35.301 MMcf

$1 \times 10^9m^3$ = 35.301 Bcf

NEEDLE PEAK A condition noted on the load duration curve that shows very high loads for relatively few days (less than 15) of the year.

NET PLANT	Gross plant less associated accumulated depreciation. (See "Gross Plant".)
NET PROCEEDS	Proceeds from the disposition of an asset or from the issue of securities after deducting the related expenses.
NORMALIZED INCOME TAXES	An estimate of income taxes based on accounting income. The estimate may be greater or smaller than the income taxes payable because of differences in the timing of the recognition of certain items of revenue and expenses for accounting as opposed to tax purposes. (See "Deferred Income Taxes", "Flow-through Income Taxes" and "Capital Cost Allowance").
OPERATING BASE EARTHQUAKE (OBE)	An earthquake of relatively low intensity such that there is a reasonable chance of its occurring during the operating life of a proposed structure or facility. In specific terms, a seismic ground motion (earthquake) which has a probability of being exceeded of 0.002 per annum (1 year in 50).

PASQUILL D	An atmospheric condition consisting of wind speeds between 2 m/s and 5 m/s. The wind blows at a steady speed with no gusts.
PASQUILL F	An atmospheric condition consisting of wind speeds less than 2 m/s. The wind blows at a steady speed with no gusts.
PEAK DAY	The day with the highest gas sendout in a given year.
PEAK DEMAND	A phrase used to describe the maximum amount of gas required over a given unit of time.
PEAKING SERVICE	A gas sales service provided under contract by a pipeline company during the winter season. The service is not subject to curtailment or interruption and includes a take-or-pay provision. (See "Take-or-Pay".)
PLANT IN SERVICE	The costs of fixed assets that are used in the provision of utility service. (See "Rate Base".)

PRICE DISCRIMINATION	Price discrimination takes place when customers which impose similar costs on the utility pay different prices for similar service.
PROBIT ANALYSIS	In assessing human or environmental risk, a method of relating the intensity of some causative factor to the degree of harm done.
PROCESS AREA OR PROCESS PLANT	Portion of plant containing gas processing equipment such as liquefaction and vapourization equipment.
PUBLIC SEPARATION ZONE	The area surrounding a facility in which no permanent residences would be allowed. It is employed to protect the public from a potential hazard.
RATE BASE	The amount the utility has invested in assets that are used or useful such as mains, meters, compressors and regulator stations, etc., minus accumulated depreciation, plus an allowance for working capital and other amounts that may be allowed by the Board.

RATE OF RETURN ON RATE BASE	The amount, including interest, which the Board allows a utility to earn net of all taxes and other expenses, expressed as a percentage of rate base.
REFRIGERANT	A liquid or gas used as a coolant in refrigeration equipment.
RESTORATION TECHNIQUES	Construction procedures and techniques used to restore the land after the facilities are installed, which would include: backfilling, grading, subsoiling, chisel ploughing, revegetation, and soil erosion control techniques.
REVENUE DEFICIENCY	Revenue deficiency is the expected difference between the revenues required to achieve the allowed annual level of earnings established by the Board and the revenue that will be produced with current rates.
SAFE SHUTDOWN EARTHQUAKE (SSE)	An earthquake so large as to have a very low probability of being exceeded during the operating life of a proposed structure or facility. Used to check that facilities are capable of withstanding a very

	large earthquake. In specific terms, a seismic ground motion (earthquake) which has a probability of being exceeded of 0.0001 per annum (1 year in 10,000).
SEISMIC	Of, subject to, or caused by an earthquake, Classified by the National Building Code into zones of varying activity levels (e.g., zone 0, zone 1, zone 2, etc).
SENDOUT	The volume of gas sent to market. It represents the difference between market demand and curtailment.
SOIL STRUCTURE	The combination or arrangement of primary soil particles (sand, silt, clay) into secondary particles, units, or natural soil aggregates. The secondary units or soil aggregates are characterized and classified on the basis of size, shape and degree of distinctness into classes, types, and grades respectively.
TAKE-OR-PAY	Gas supply contracts often contain a provision so that gas contracted for, but not taken, will be paid for.

TANK DIKE	Impounding area around and/or adjacent to a storage tank having adequate volume to contain full tank contents.
TEMPERATURE INVERSION	An abnormal condition in the lower atmosphere in which temperature increases with increased elevation (normally temperature decreases with increased elevation).
TEMPERATURE SENSITIVE CUSTOMERS	Customers whose gas consumption varies with the weather, temperature and wind.
TEMPERATURE SENSITIVE LOAD	A demand on a utility gas load that is proportional to the ambient temperature and wind.
TEMPORARY WINTER SERVICE (TWS)	A gas sales service provided by TCPL under contract by a pipeline during the winter season. The service is subject to limited curtailment or interruption and includes a take-or-pay provision. (See "Take-or-Pay".)
TOPOGRAPHY	The surface features of an area, including hills, valleys etc.

UPPER FLAMMABLE LIMIT (UFL)	The highest concentration of flammable gas in air which can be ignited. For natural gas the UFL is 15 per cent.
VALUE OF SERVICE RATES	Rates not set on the basis of cost, but rather the value of gas service to the customer, usually in relation to alternative service or forms of energy.
VARIABLE COSTS	Costs that vary with throughput, for example compressor fuel costs for gas pipelines and power costs for oil pipelines. (See "Fixed Costs".)
VISCOSITY	The resistance of a fluid to the motion of its molecules among themselves, hence, a measure of the resistance to flow.
WET CROSSING	A method of installing a pipeline across a watercourse by trenching, installing the pipe and backfilling while the watercourse continues to flow.
WINTER PEAKING SERVICE (WPS)	See "Peaking Service".

WORK-IN-PROGRESS	An account which accumulates the costs incurred during construction including direct labour and materials but not including interest charges.
WORKING CAPITAL	For regulatory purposes working capital represents capital employed by the utility in addition to the investment in plant in service. An allowance for working capital is included in the rate base and consists of items such as cash working capital and materials and supplies inventory. (See "Cash Working Capital".)
ZONING BY-LAW	A municipal by-law to control the use of land and buildings and to regulate the height, bulk, location, size, floor area, spacing, character and use of buildings or structures. Typically a zoning by-law will define different zones on a map, each with its own list of permitted uses, minimum lot sizes, frontage and yard or setback dimensions, maximum building height, minimum number of parking spaces, and other development restrictions.